AD-A152 327 BUHNE POINT HUMBOLDT BAY CALIFORNIA DESIGN FOR THE PREVENTION OF SHORELIN.. (U) COASTAL ENGINEERING RESEARCH CENTER VICKSBURG MS R R BOTTIN ET AL. NOV 84 CERC-84-5 F/G 13/2 NL

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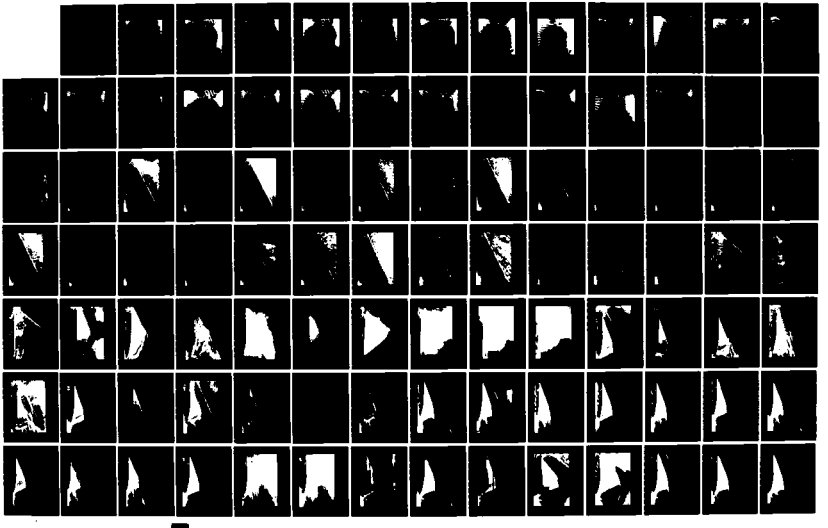
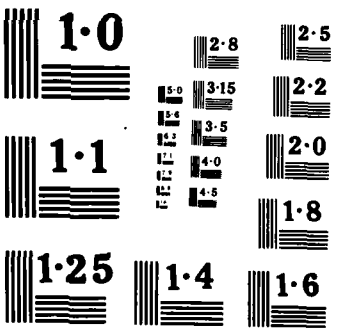
UNCLASSIFIED

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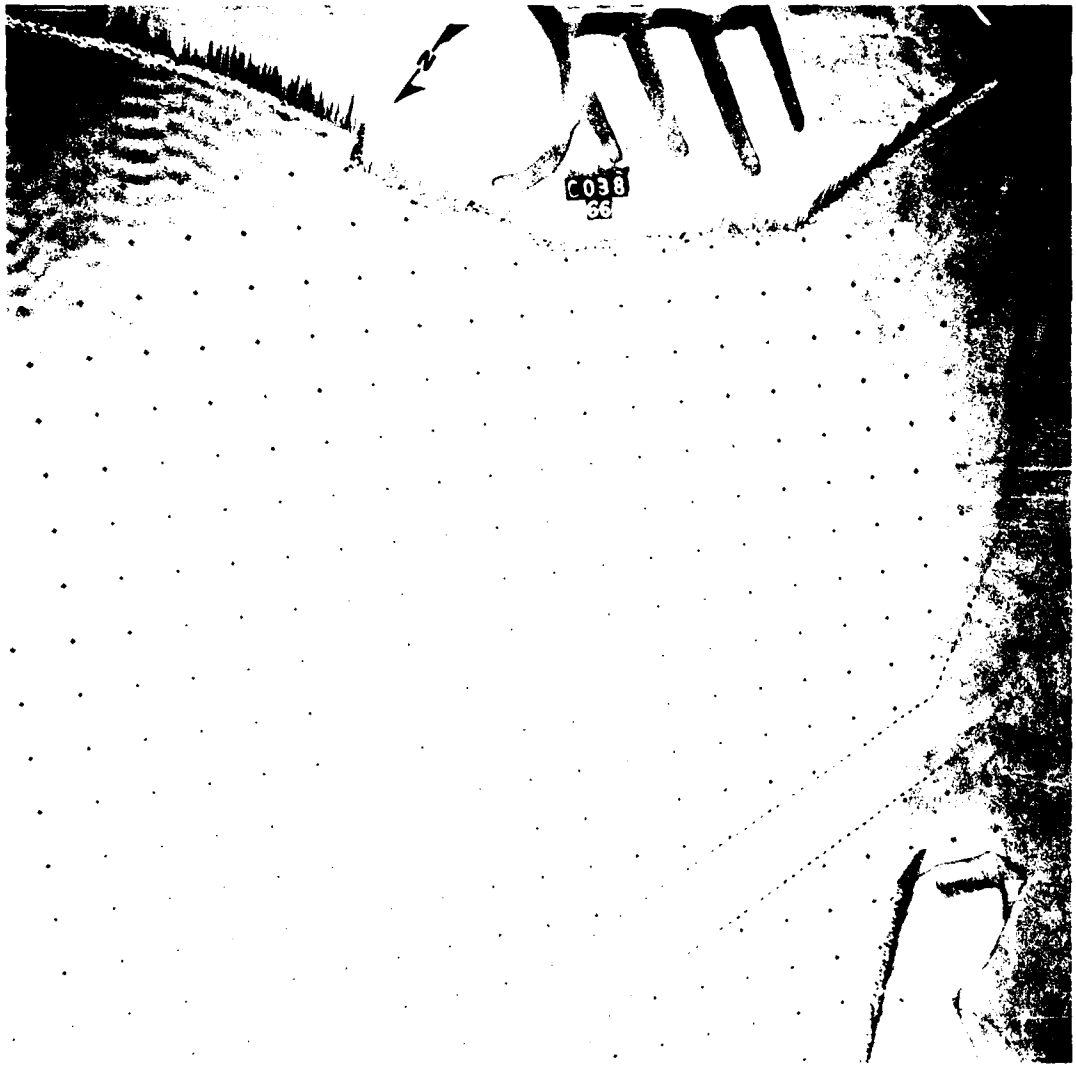

Photo 14. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from northwest for maximum flood; +3.2 ft swl

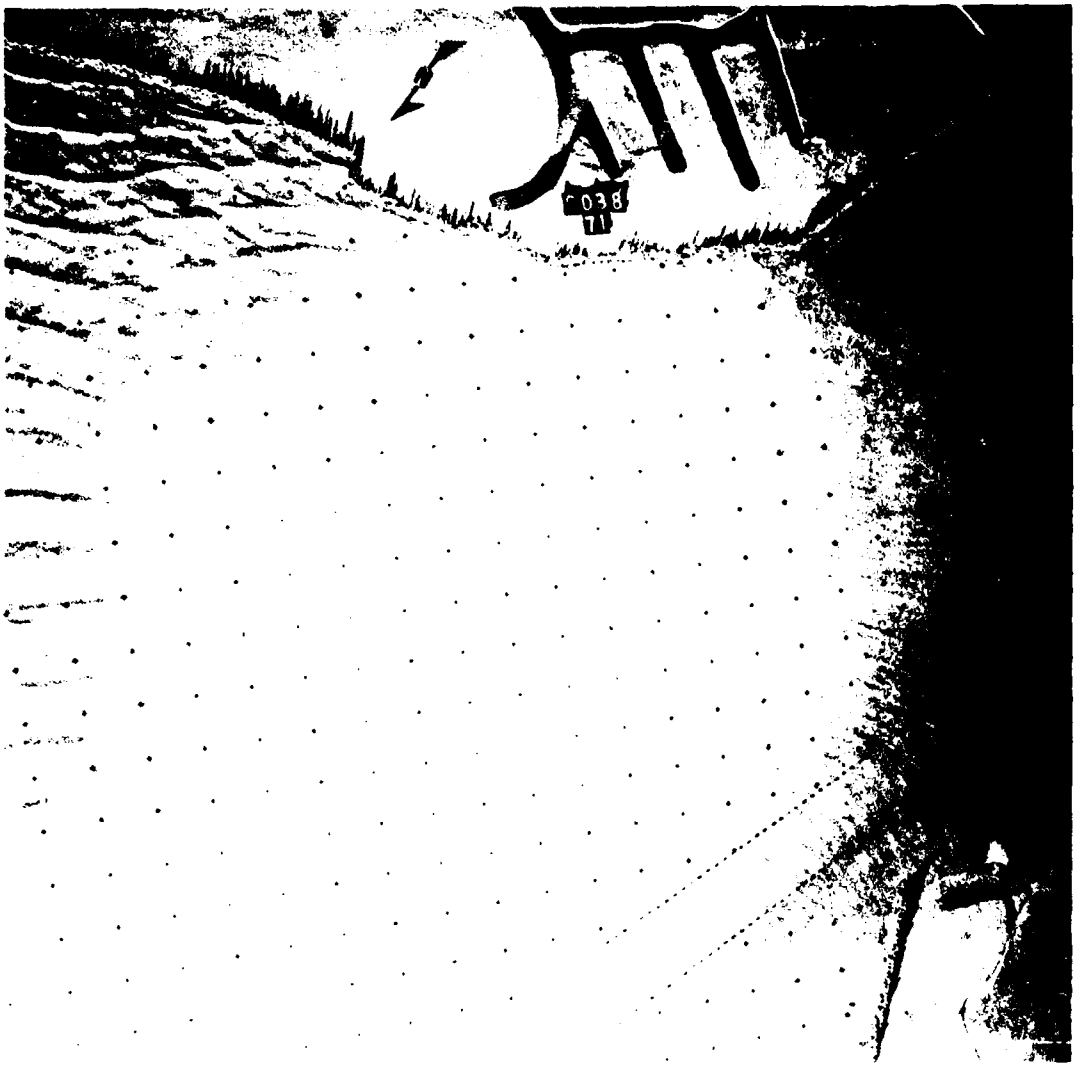

Photo 15. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from northwest for maximum flood; +3.2 ft swl

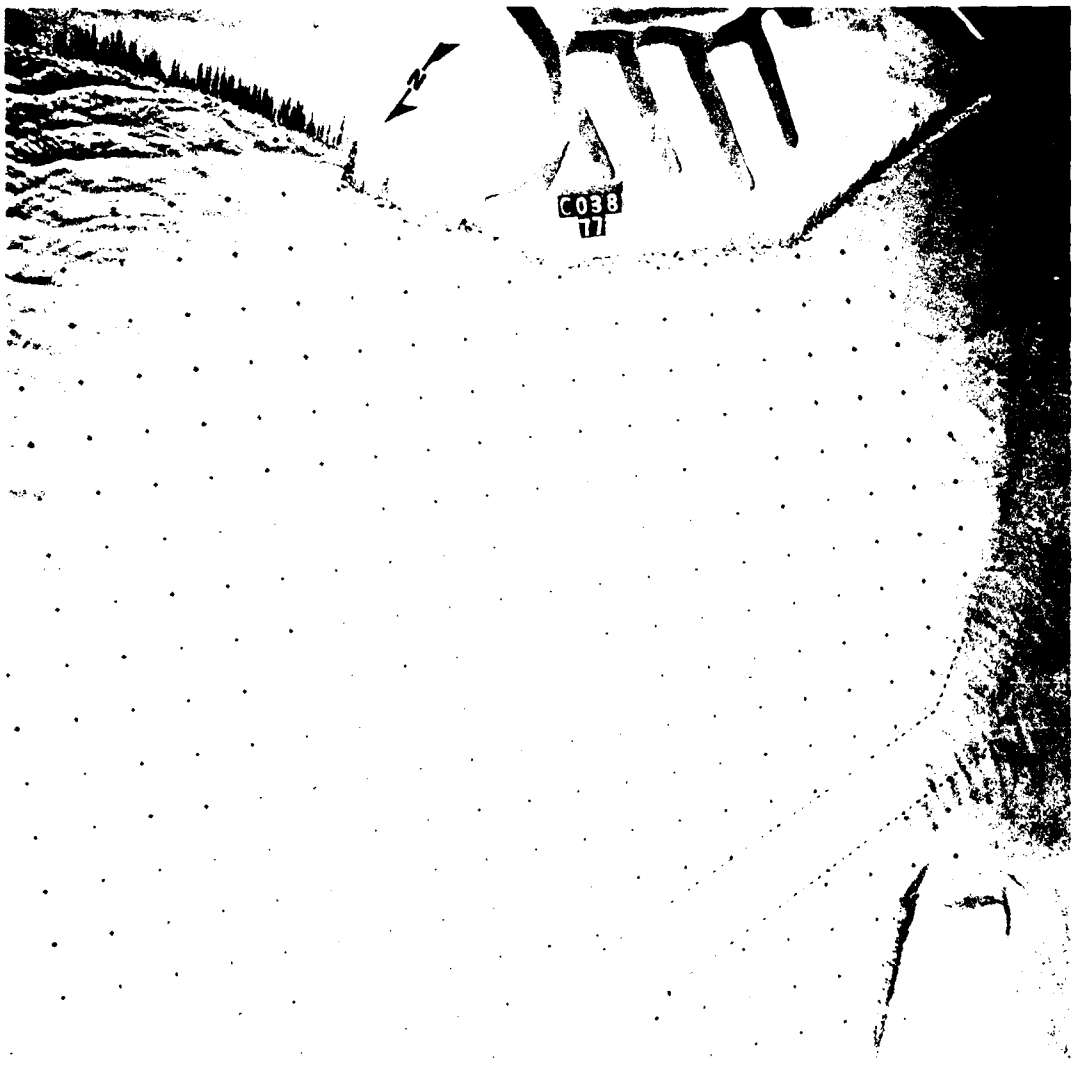

Photo 16. Typical wave patterns approaching Buhne Point for 15-sec, 17-ft waves from northwest for maximum flood; +3.2 ft swl

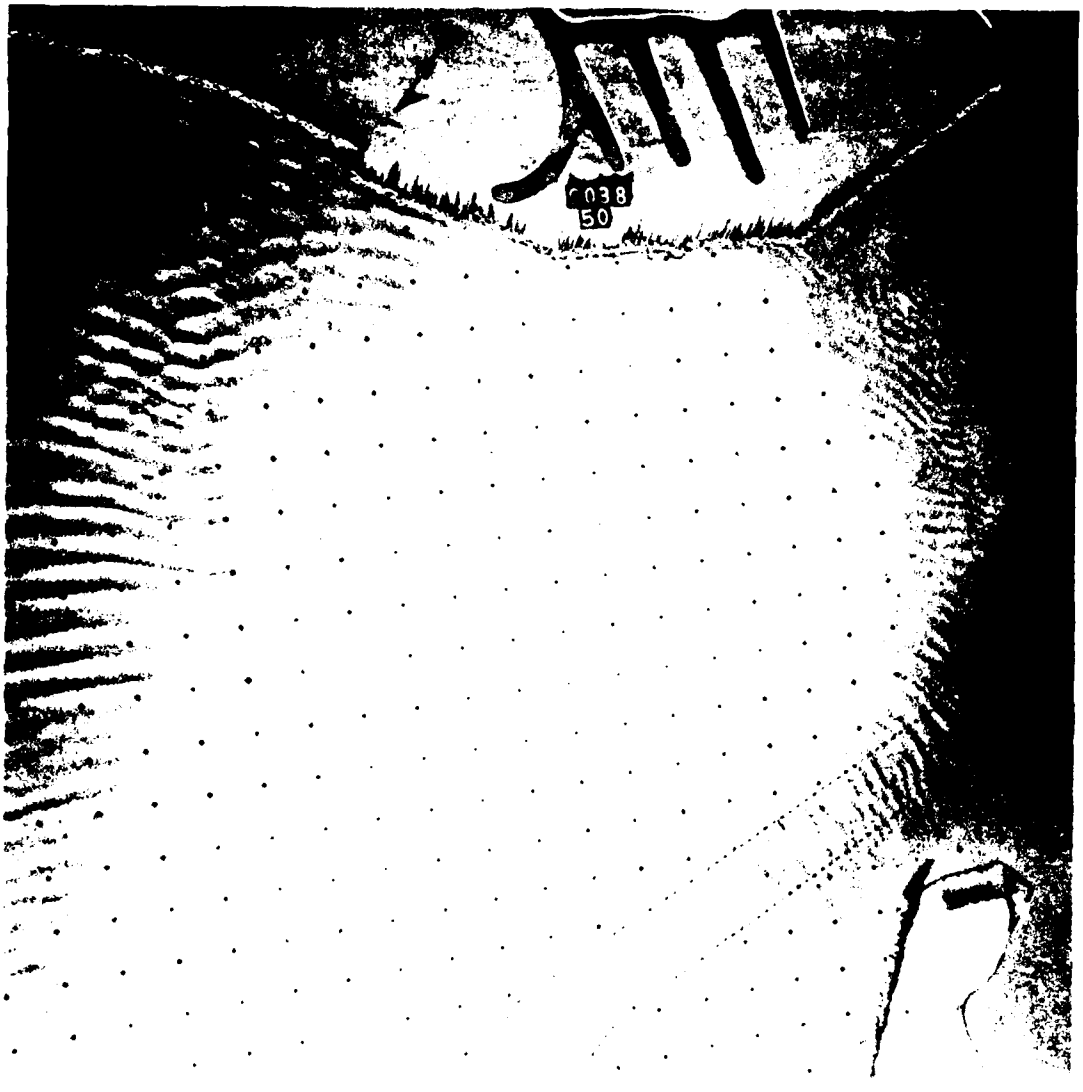

Photo 17. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from northwest for maximum ebb; +3.7 ft swl

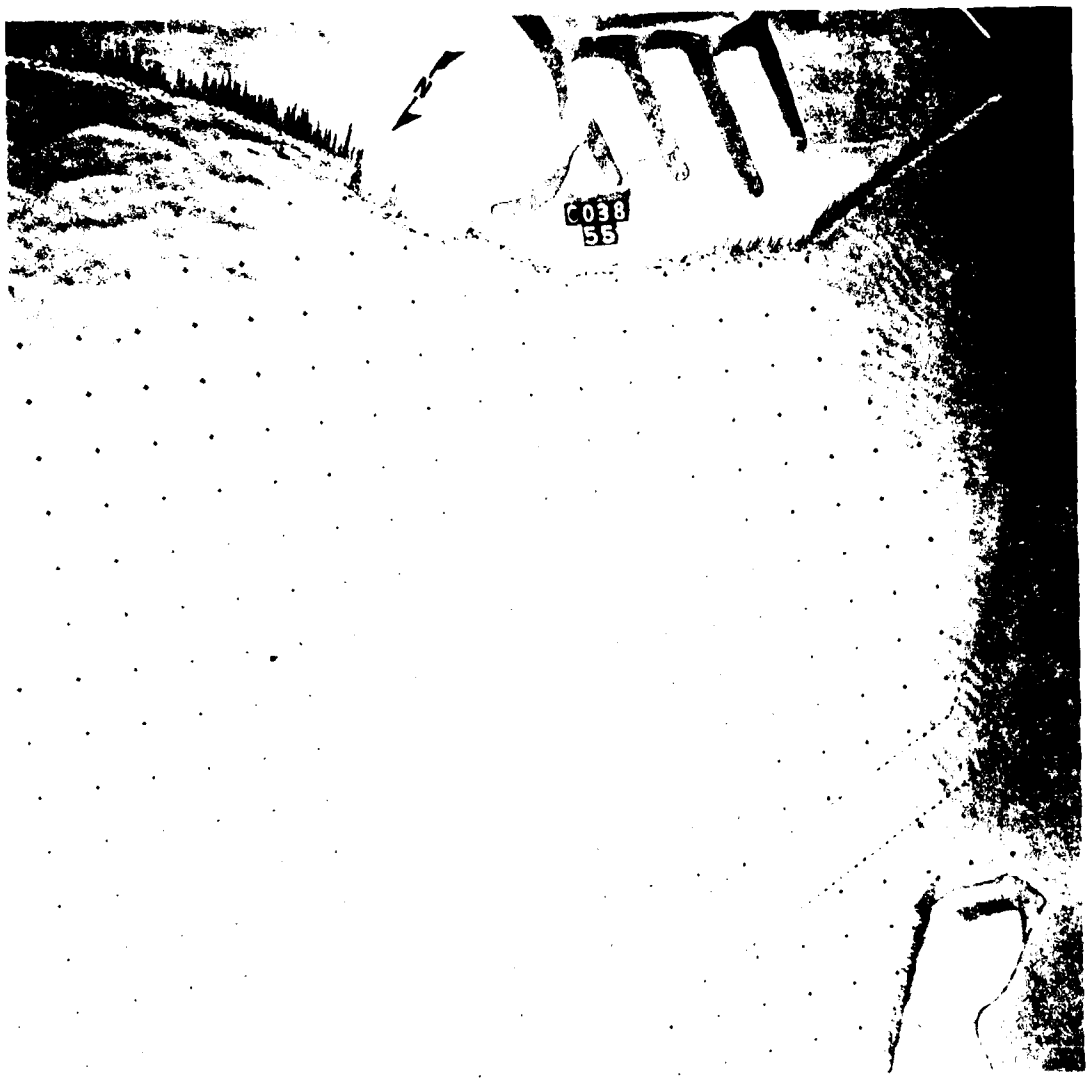

Photo 18. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from northwest for maximum ebb; +3.7 ft swl

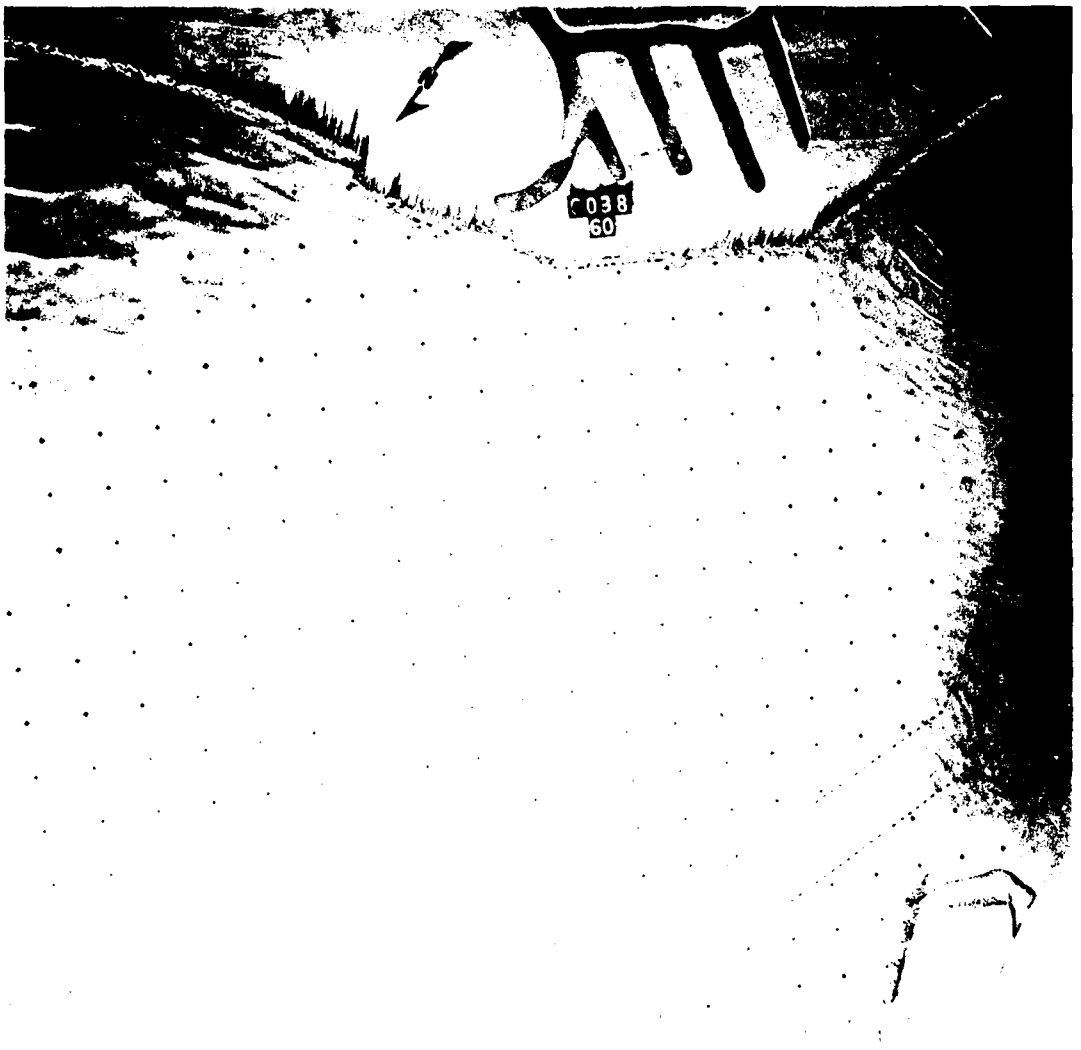

Photo 19. Typical wave patterns approaching Buhne Point for 15-sec, 9-ft waves from northwest for maximum ebb; +3.7 ft swl

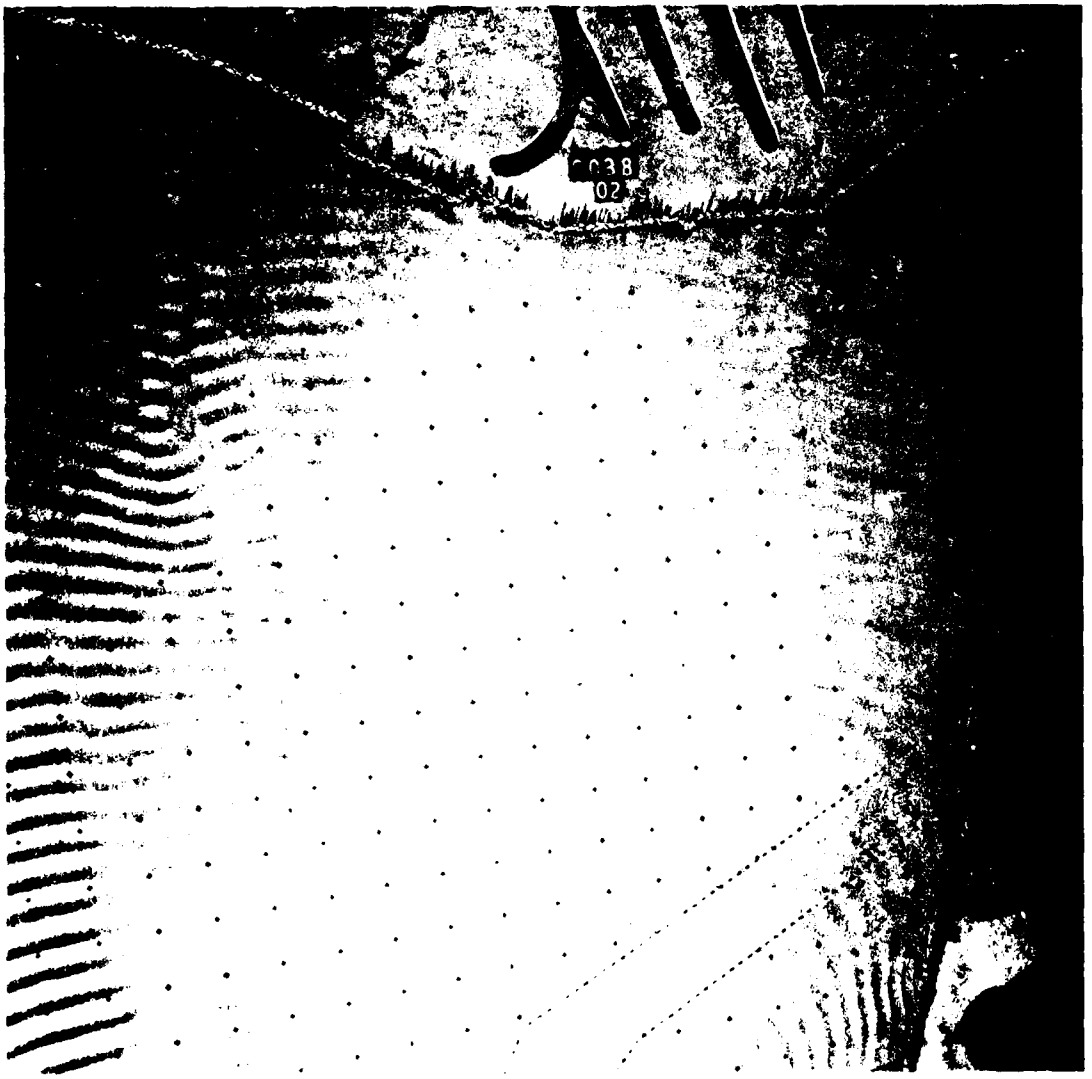

Photo 20. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from northwest; +6.7 ft swl

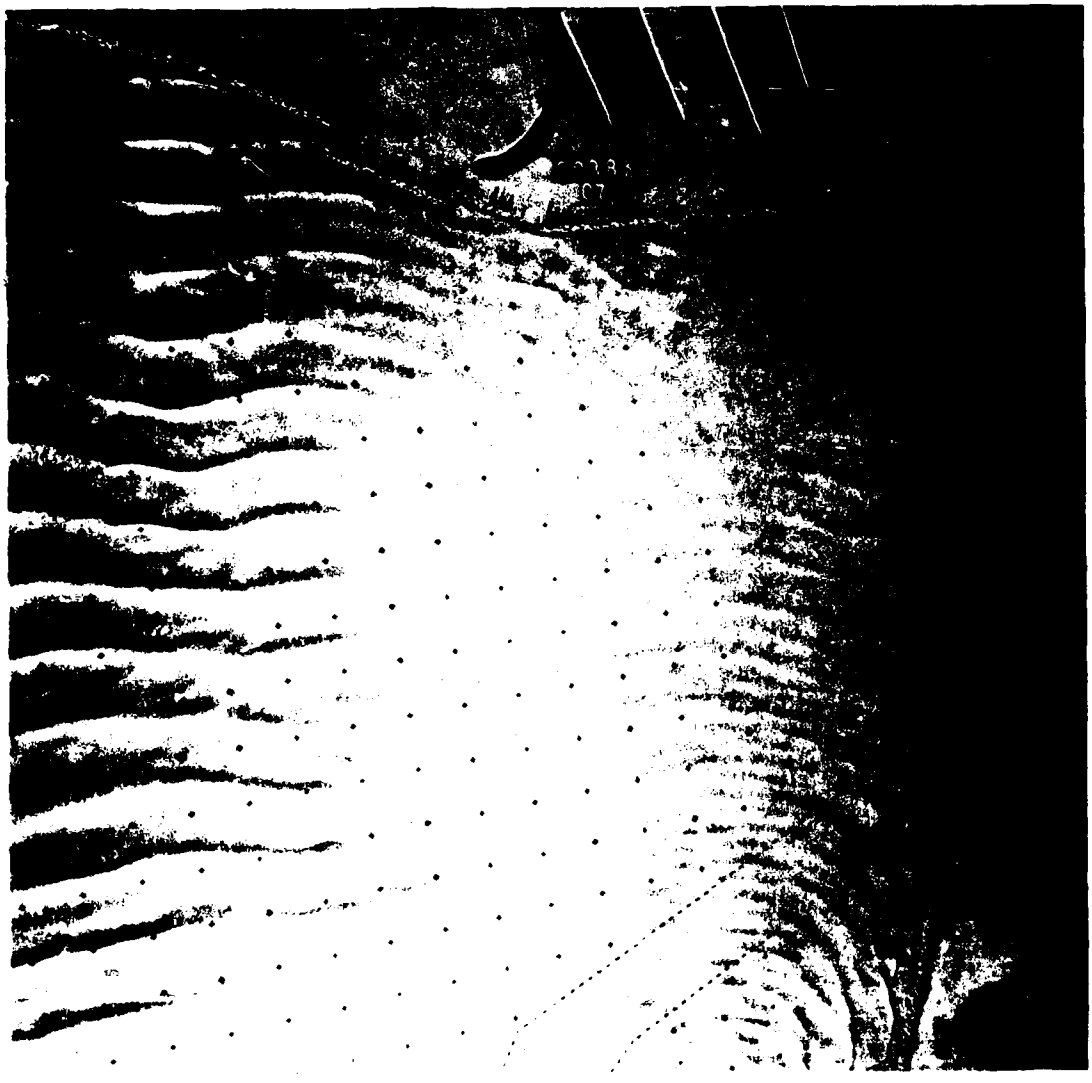

Photo 21. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from northwest; +6.7 ft swl

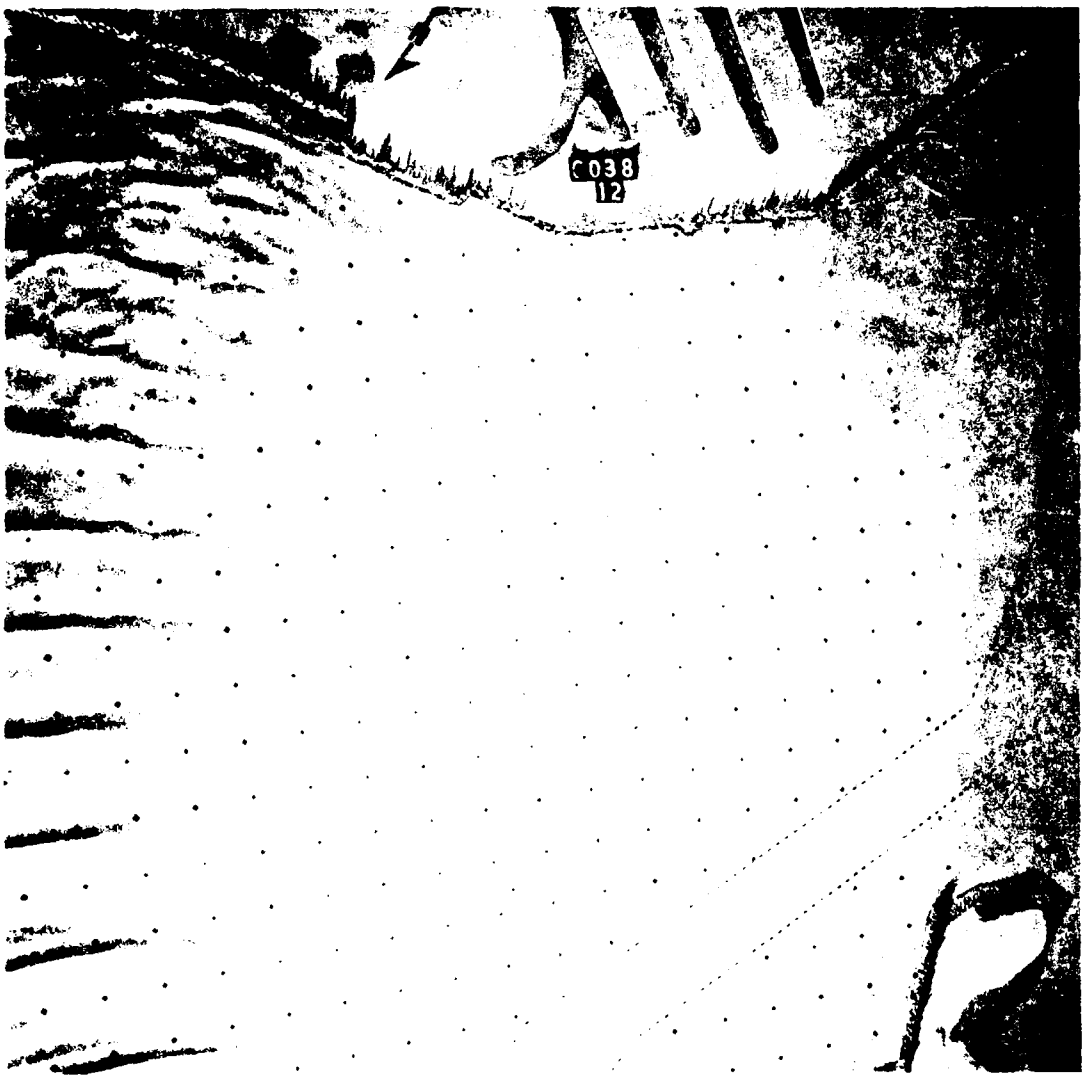

Photo 22. Typical wave patterns approaching Buhne Point for 15-sec, 9-ft waves from northwest; +6.7 ft swl

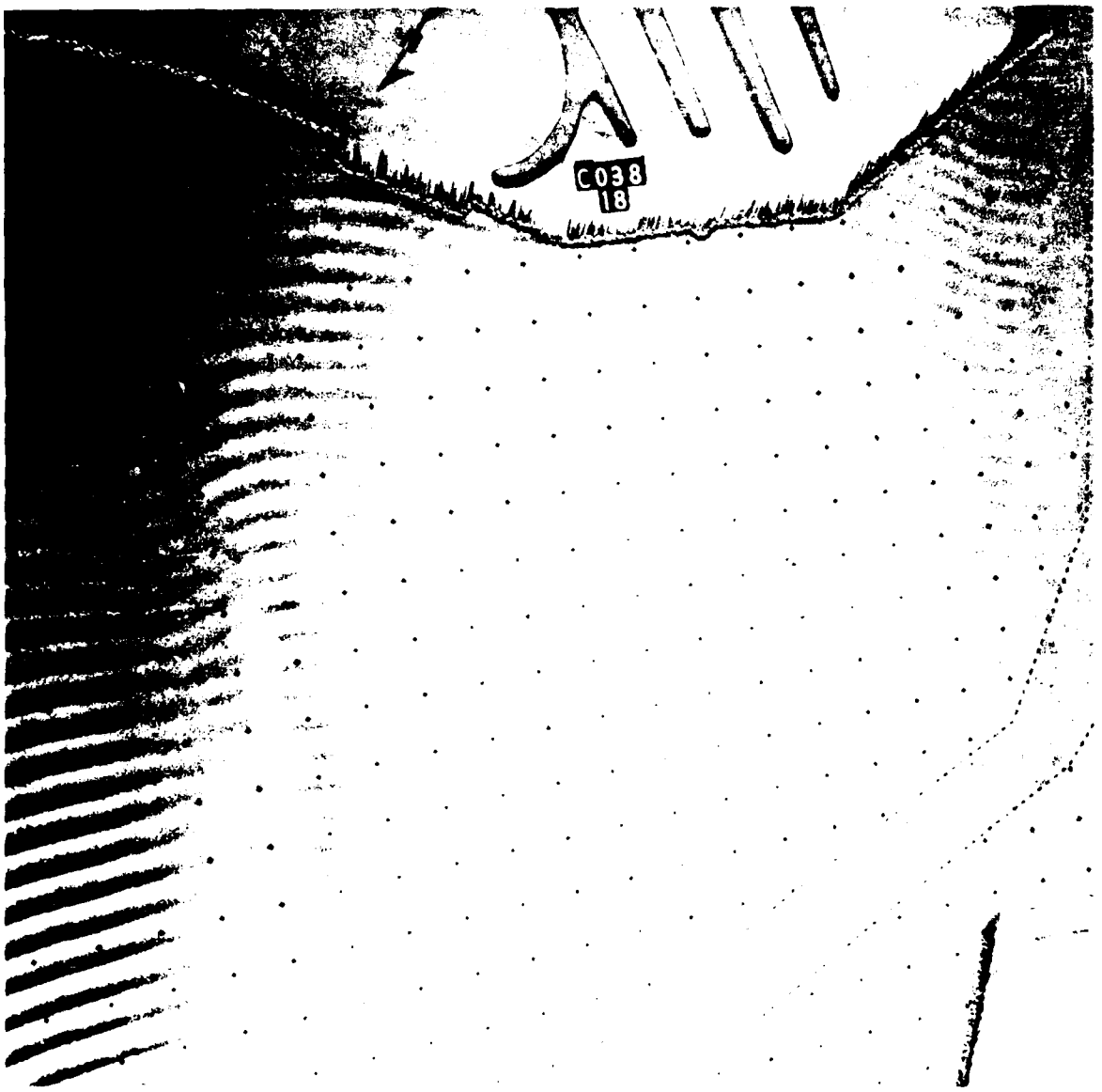

Photo 23. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from northwest; +9.5 ft swl

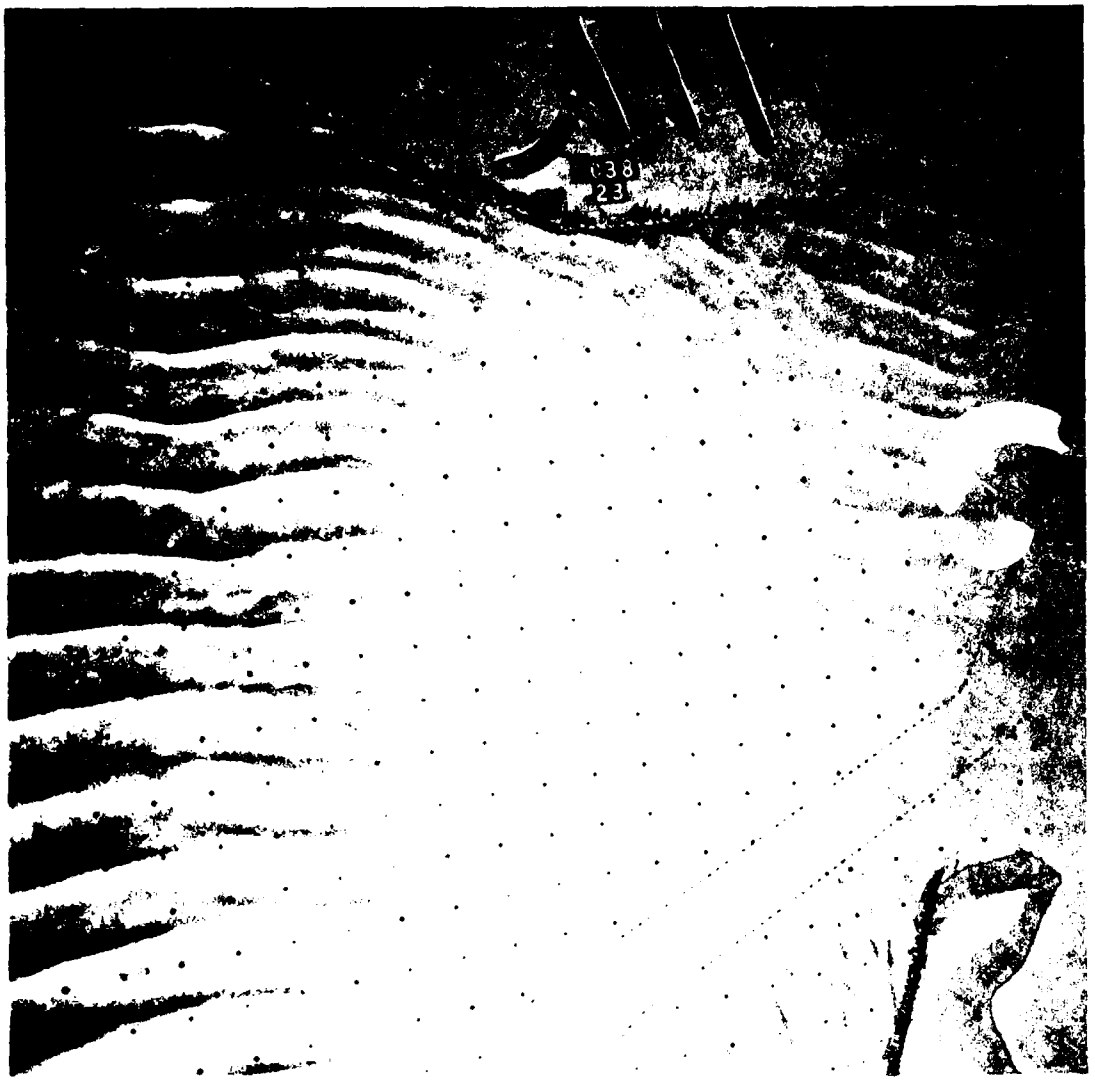

Photo 24. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from northwest; +9.5 ft swl

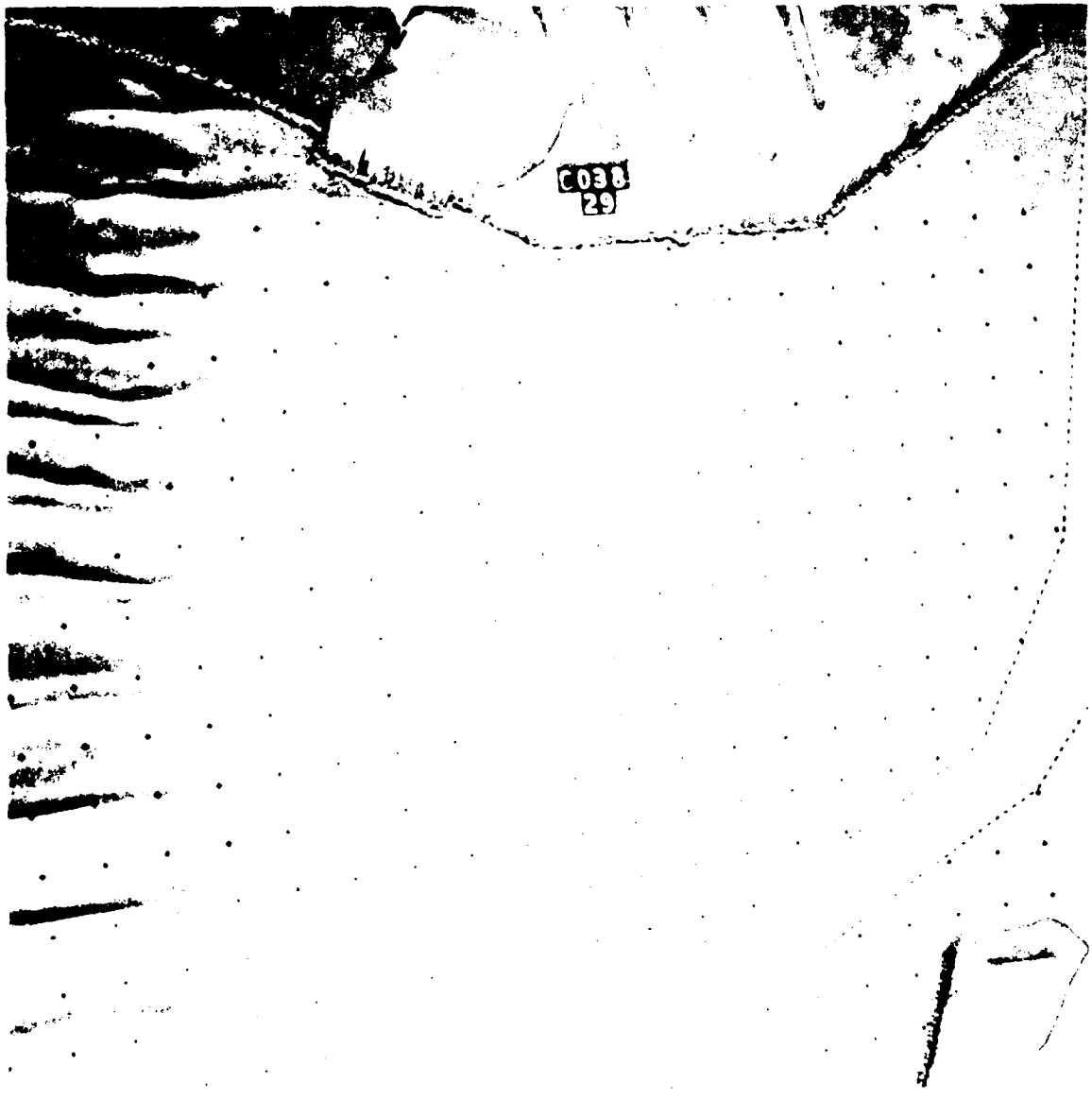

Photo 25. Typical wave patterns approaching Buhne Point for 15-sec, 17-ft waves from northwest; +9.5 ft swl

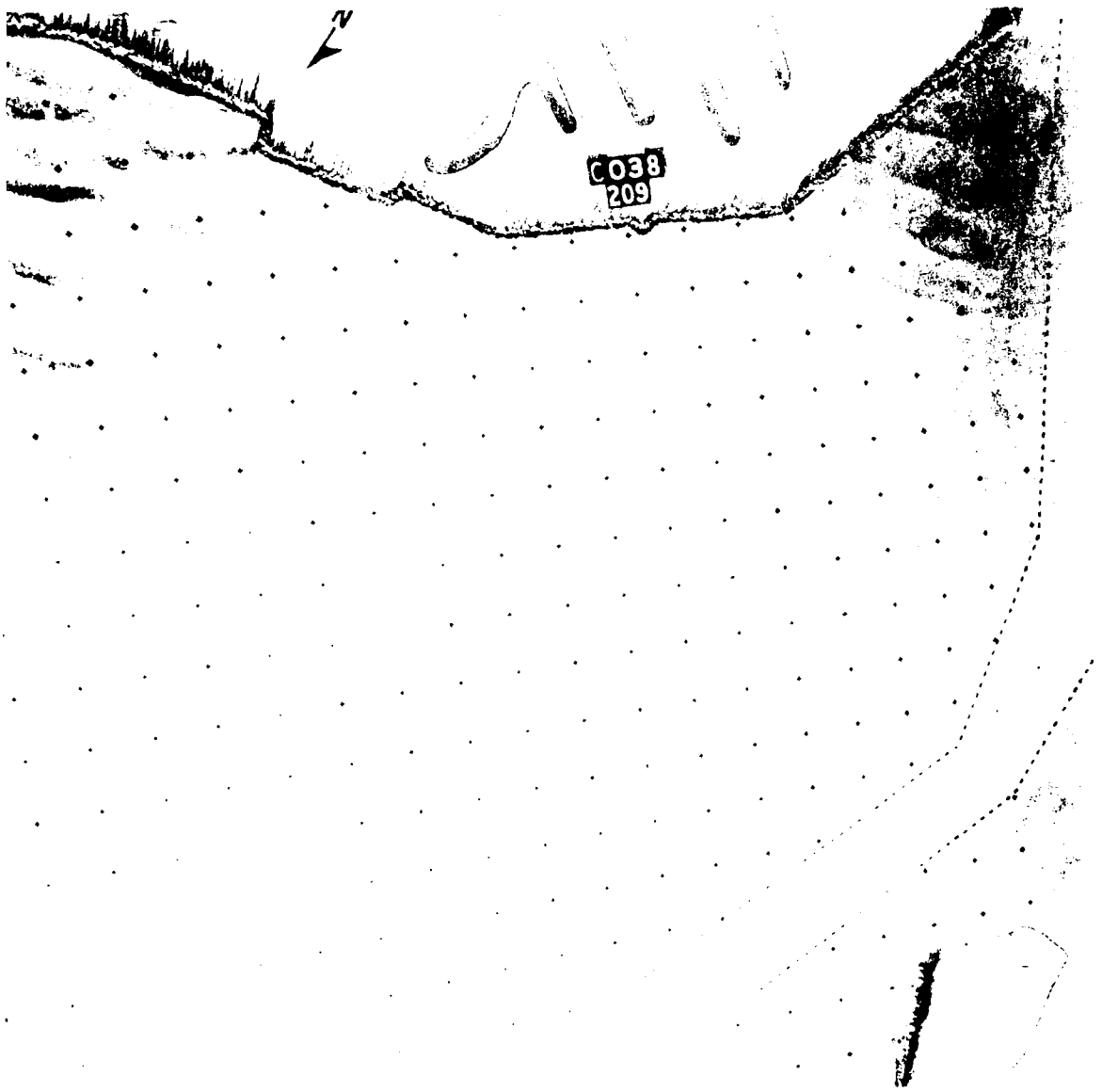

Photo 39. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from west; +9.5 ft swl

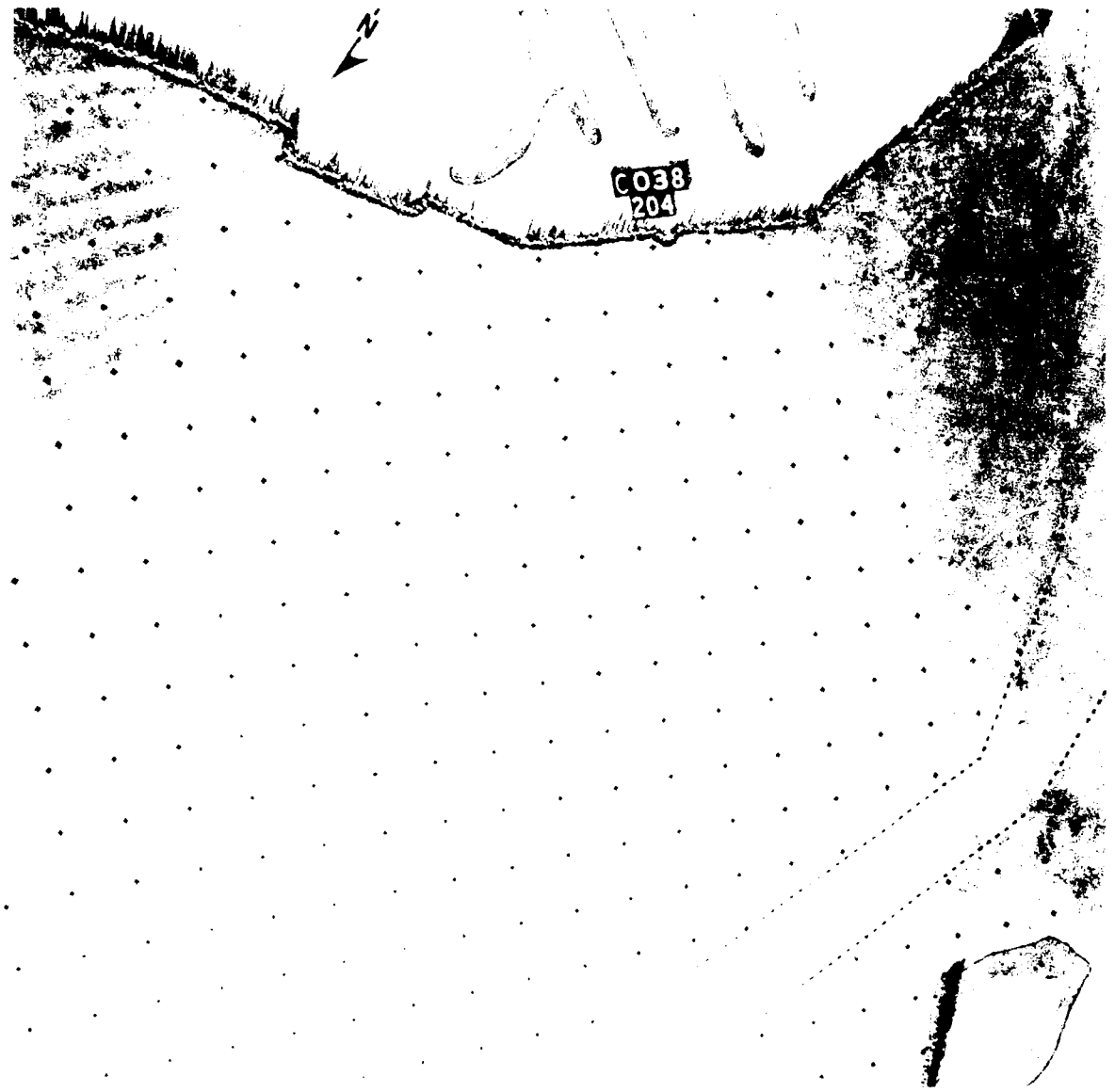

Photo 38. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from west; +9.5 ft swl

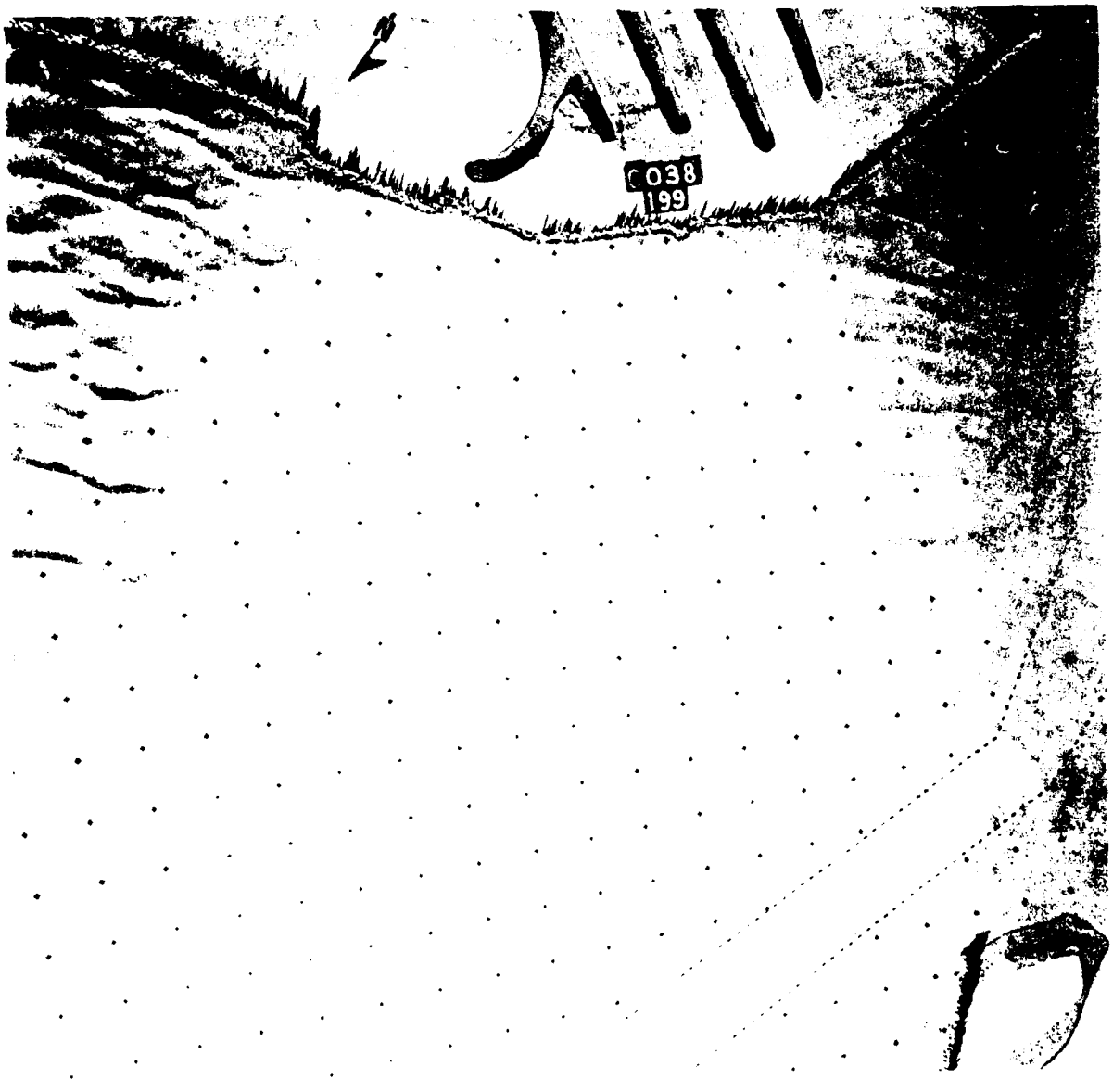

Photo 37. Typical wave patterns approaching Buhne Point for 15-sec, 11-ft waves from west; +6.7 ft swl

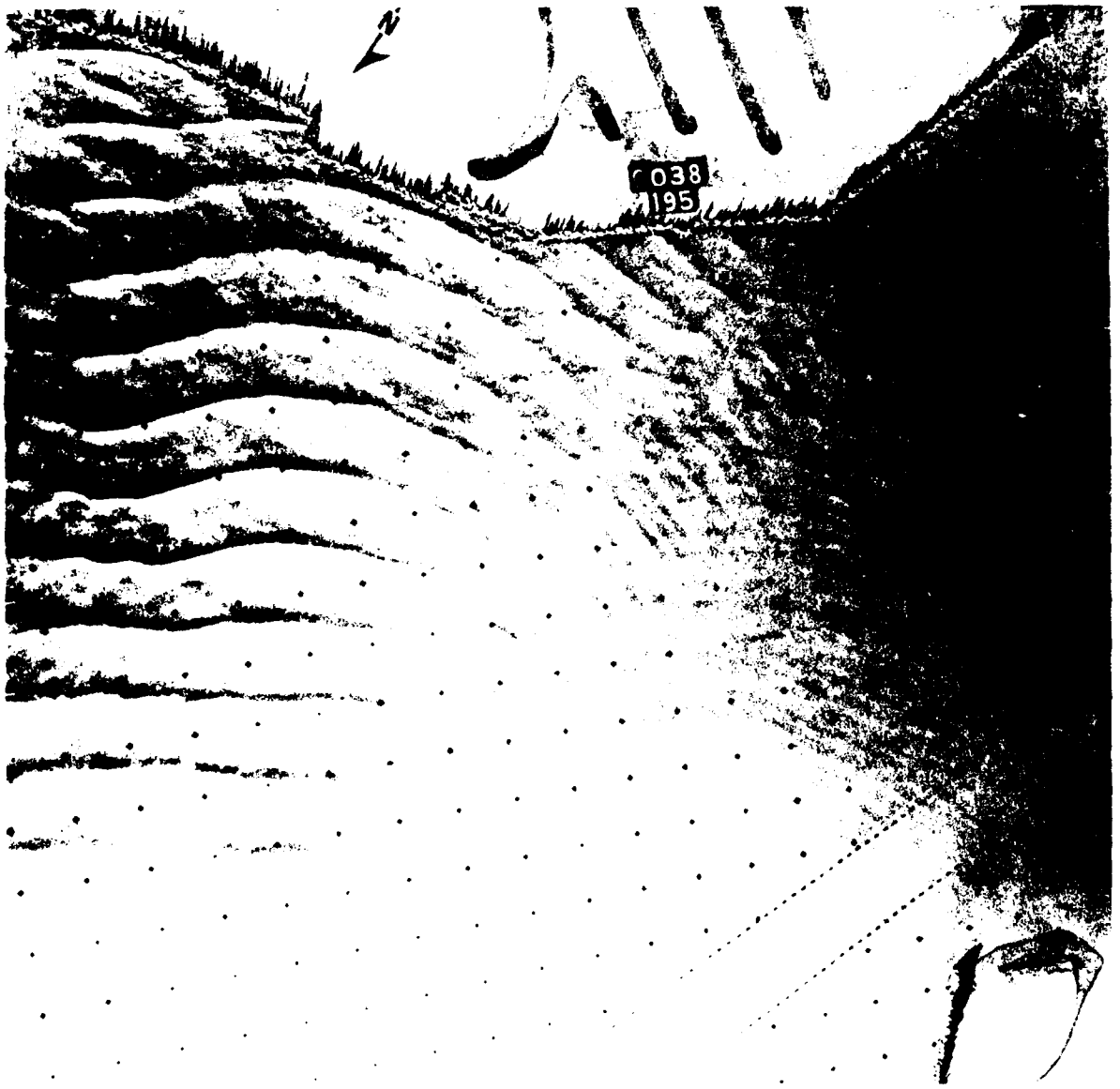

Photo 36. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from west; +6.7 ft swl

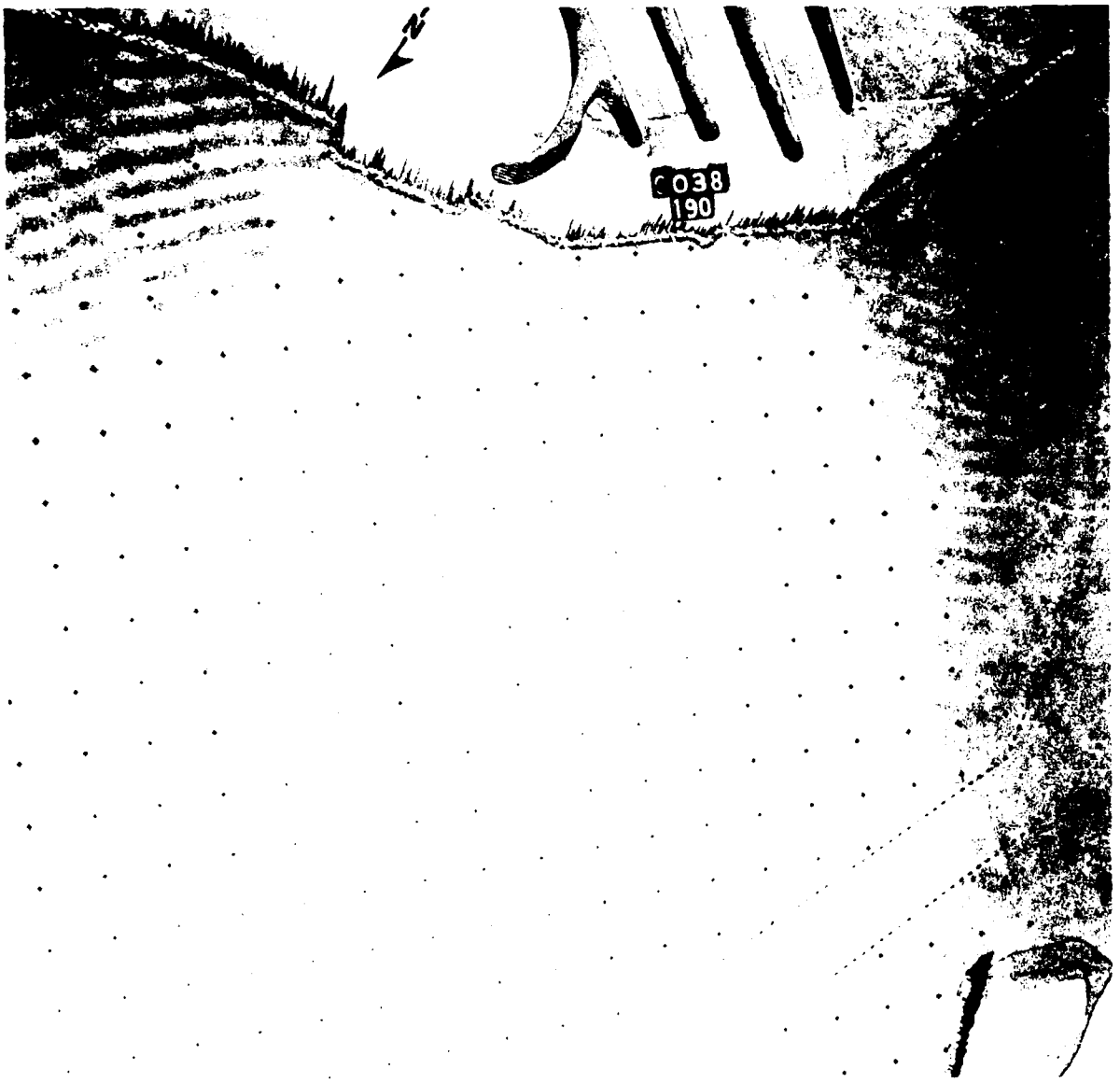

Photo 35. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from west; +6.7 ft swl

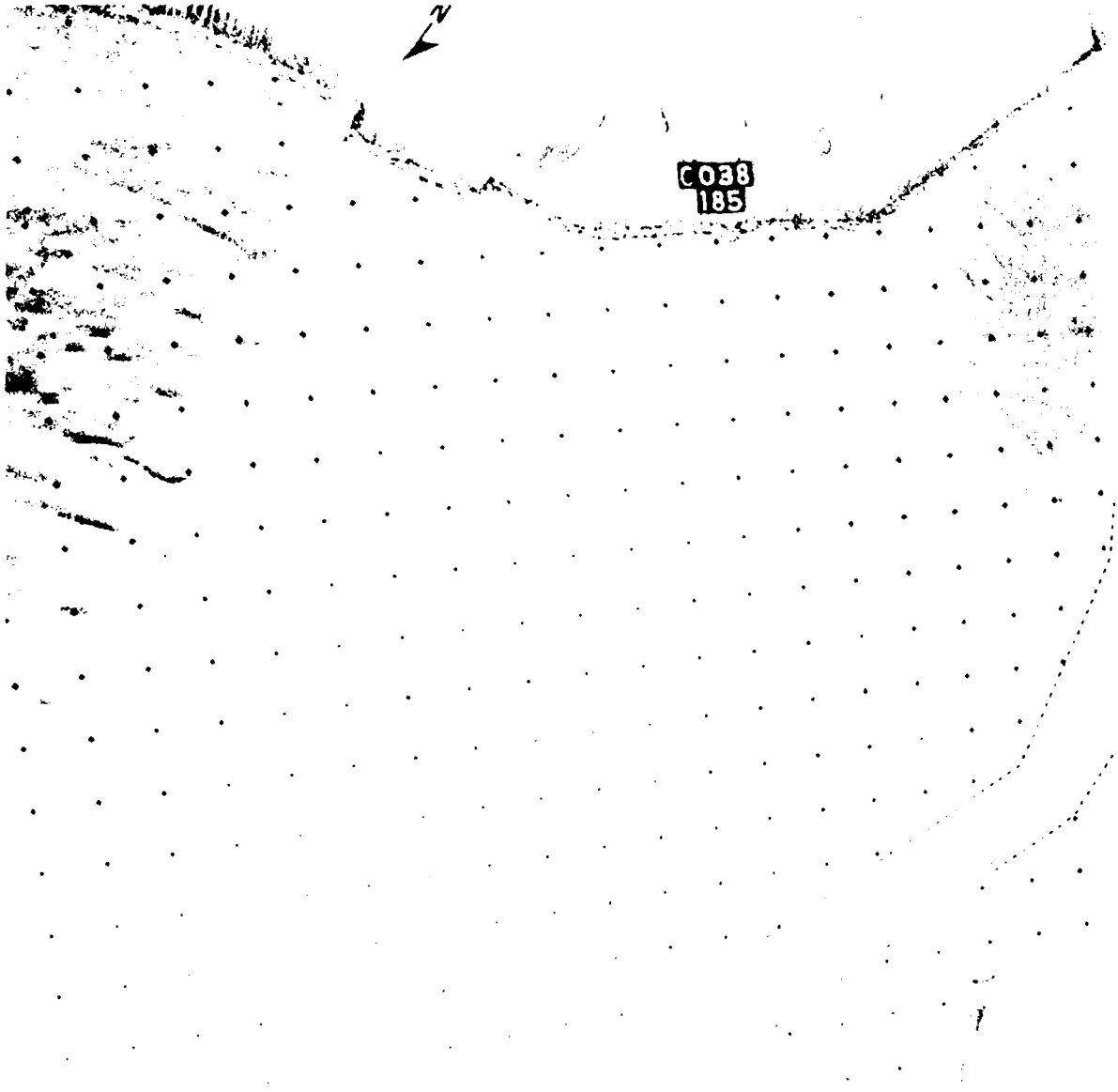

Photo 34. Typical wave patterns approaching Buhne Point for 15-sec, 11-ft waves from west for maximum ebb; +3.7 ft swl

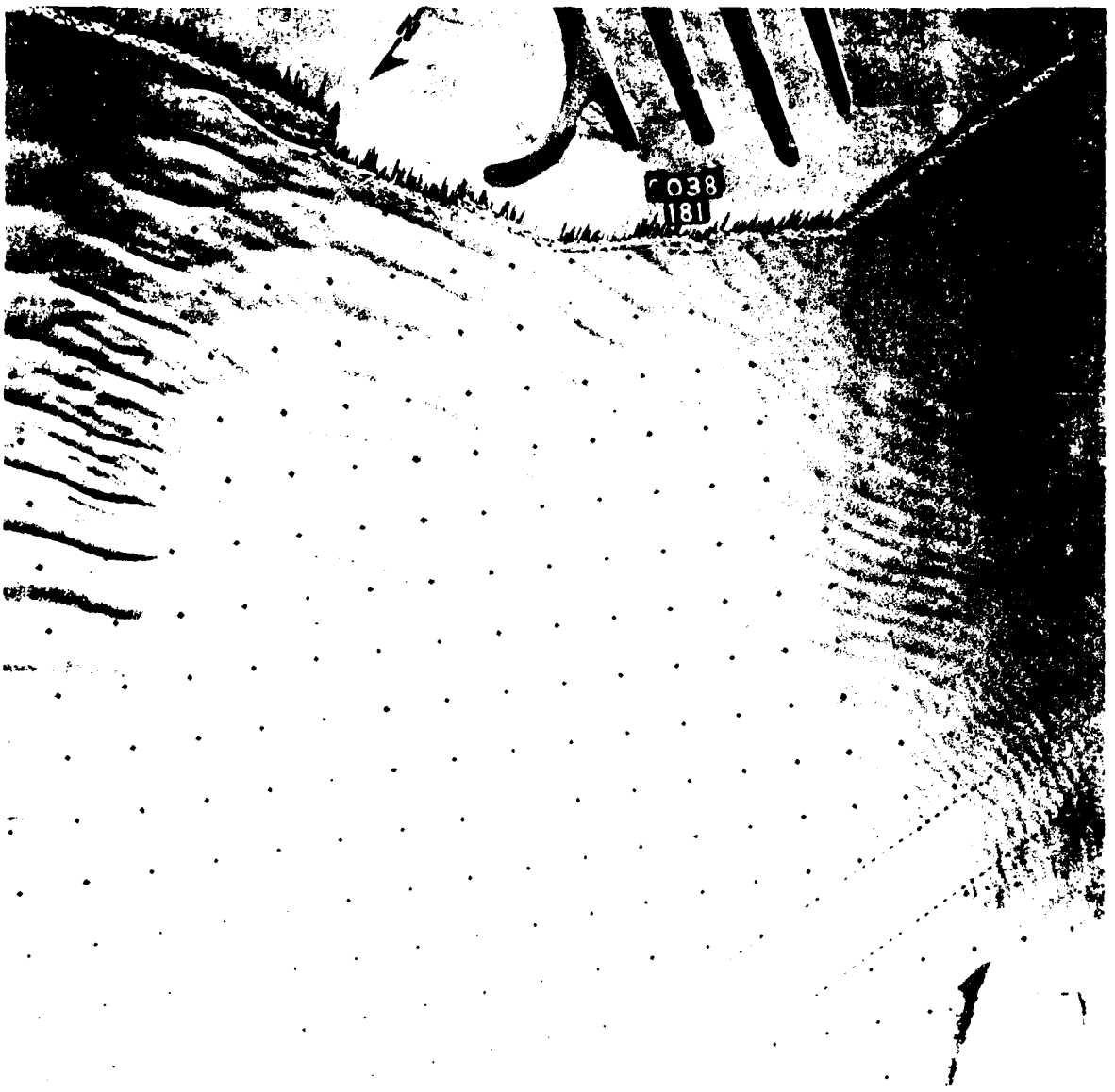

Photo 33. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from west for maximum ebb; +3.7 ft swl

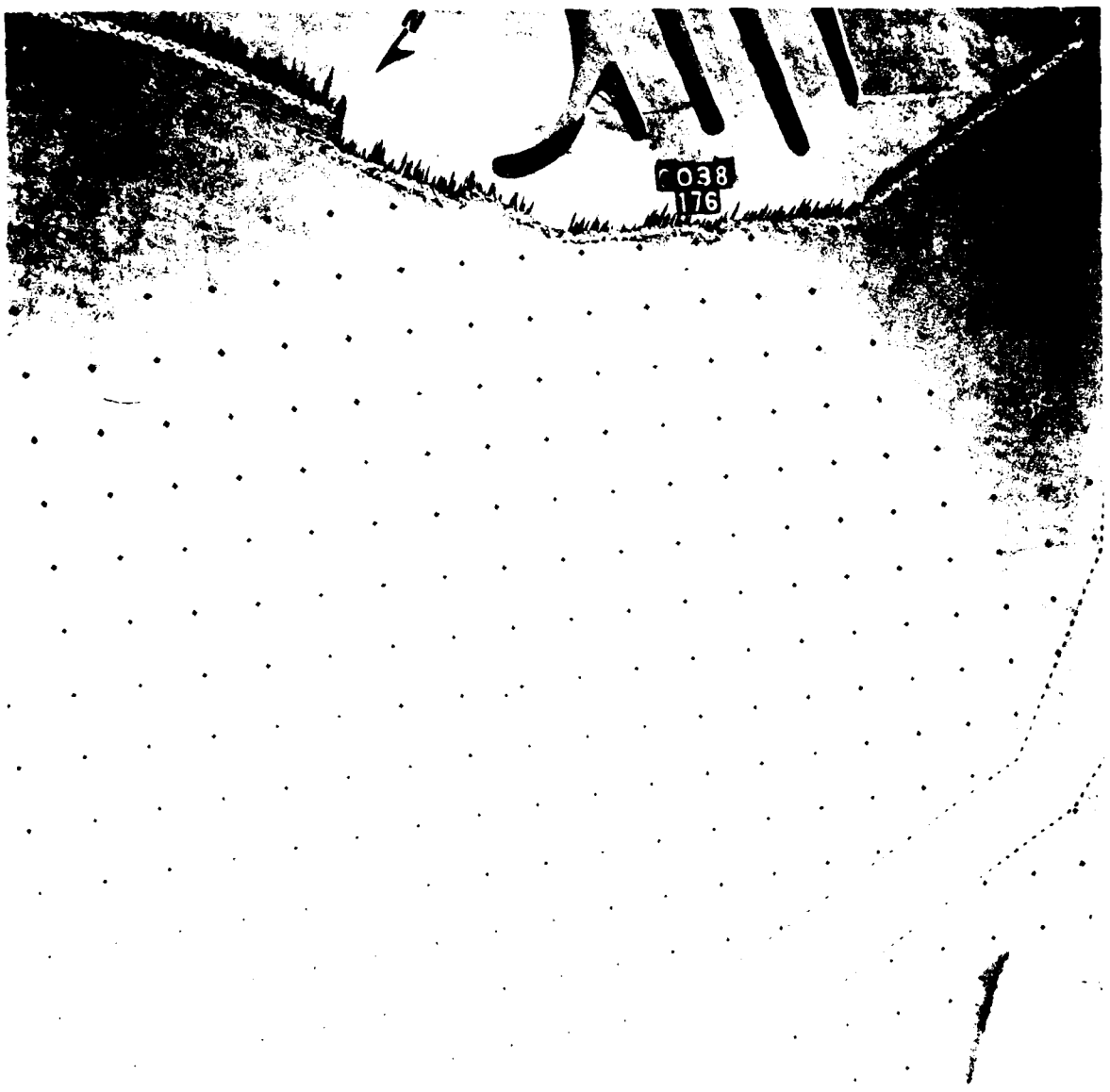

Photo 32. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from west for maximum ebb; +3.7 ft swl

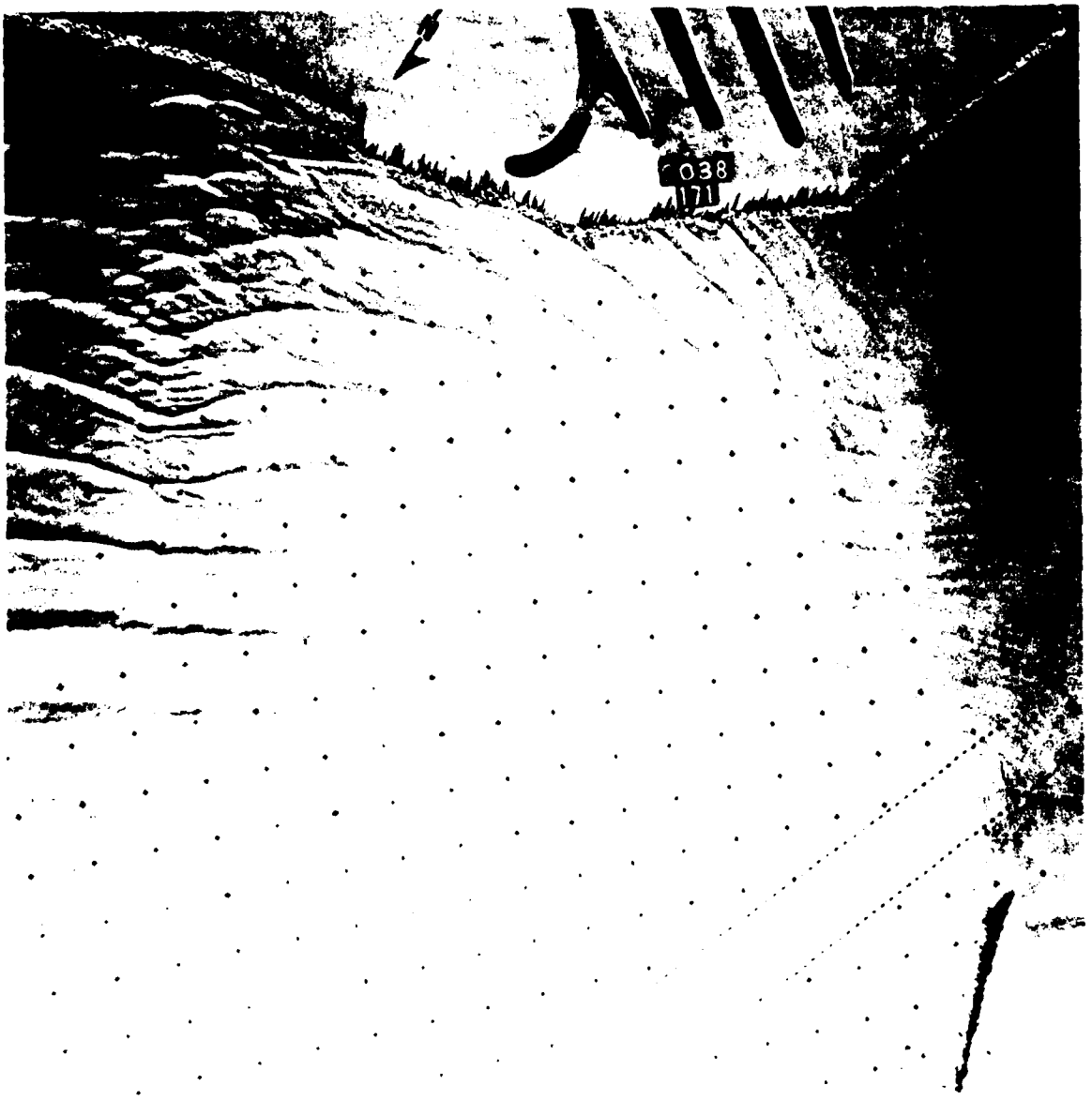

Photo 31. Typical wave patterns approaching Buhne Point for 15-sec, 11-ft waves from west for maximum flood; +3.2 ft swl

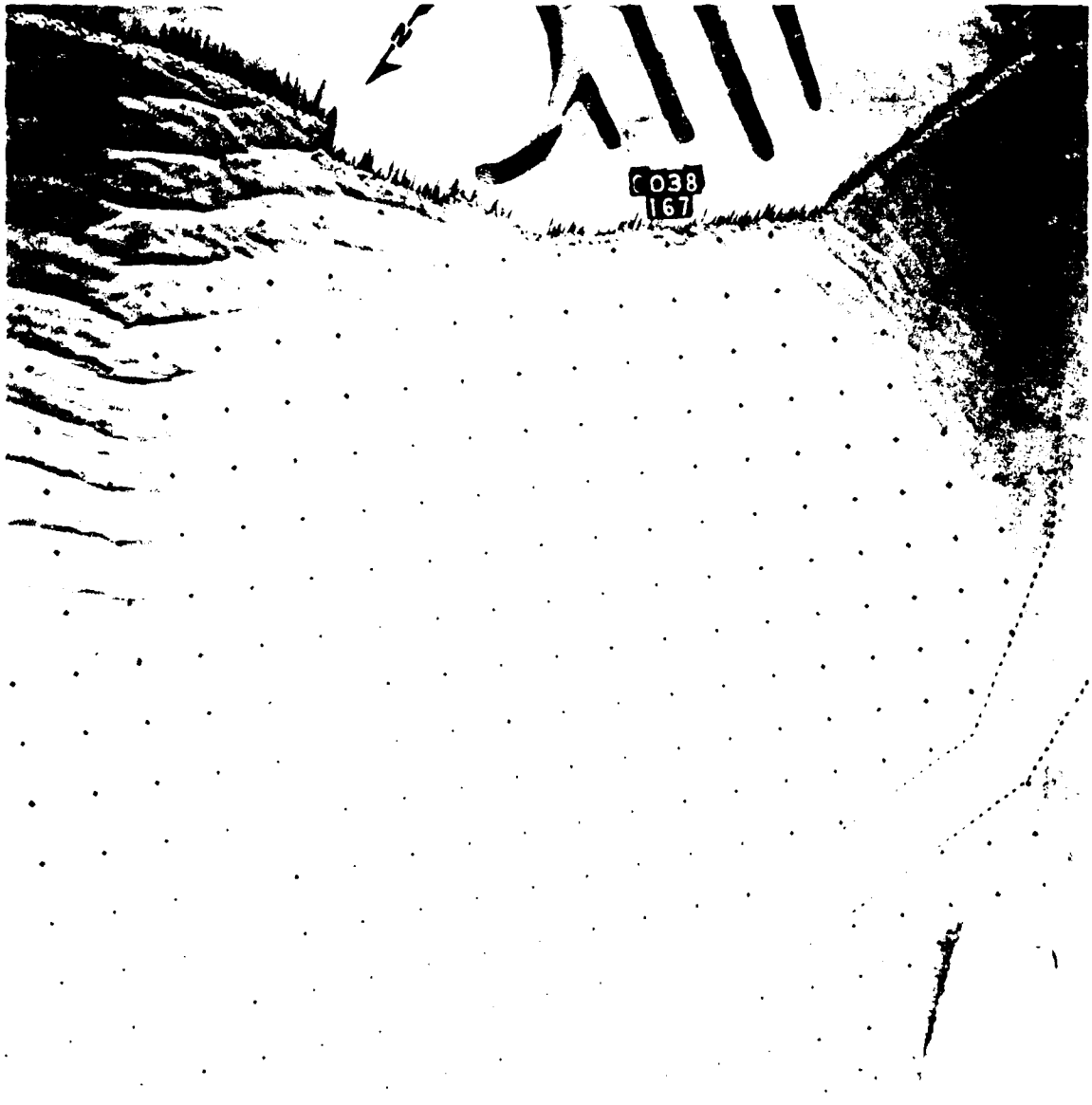

Photo 30. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from west for maximum flood; +3.2 ft swl

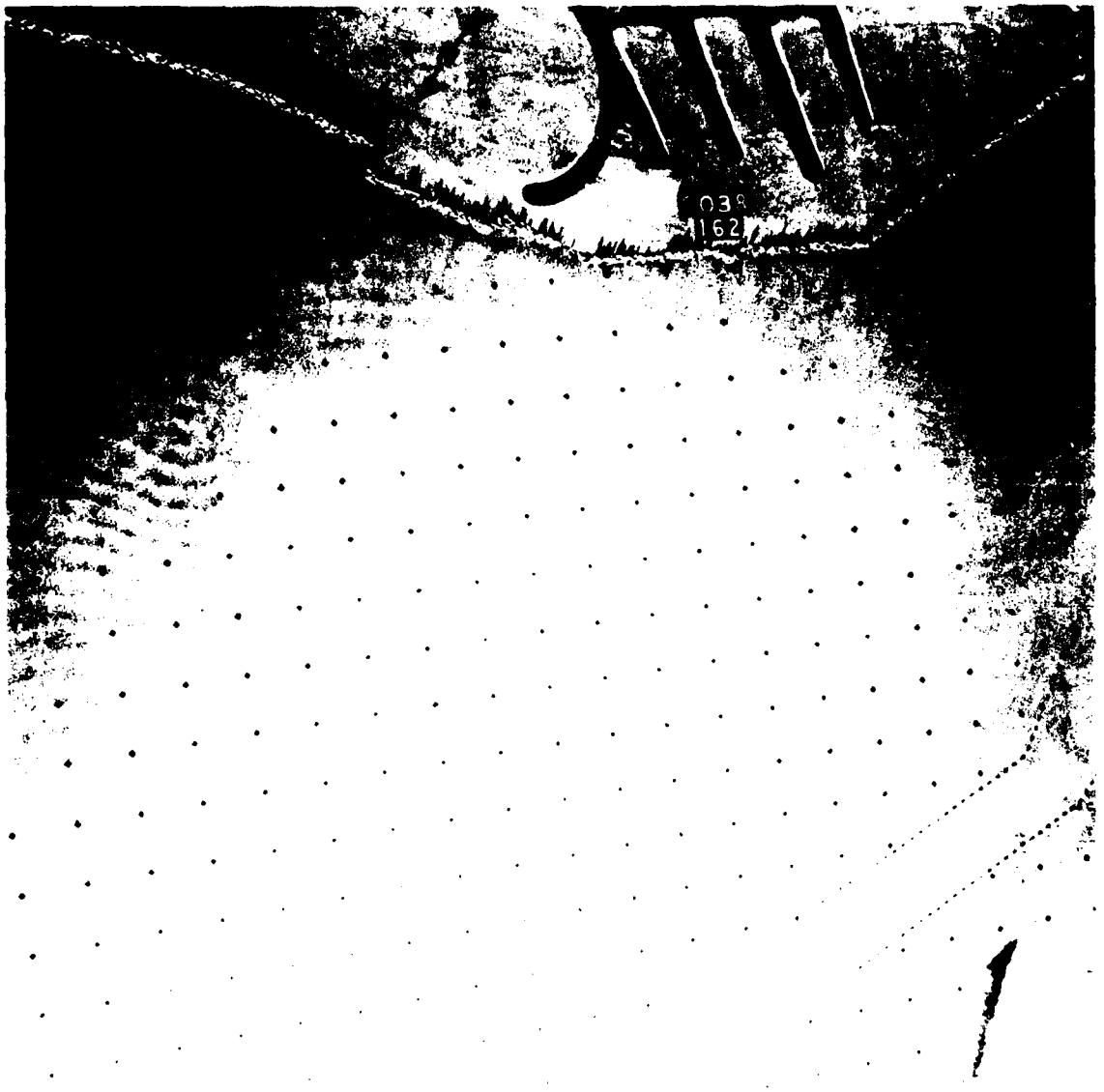

Photo 29. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from west for maximum flood; +3.2 ft swl

Photo 28. Typical wave patterns approaching Buhne Point for 15-sec, 11-ft waves from west; 0.0-ft swl

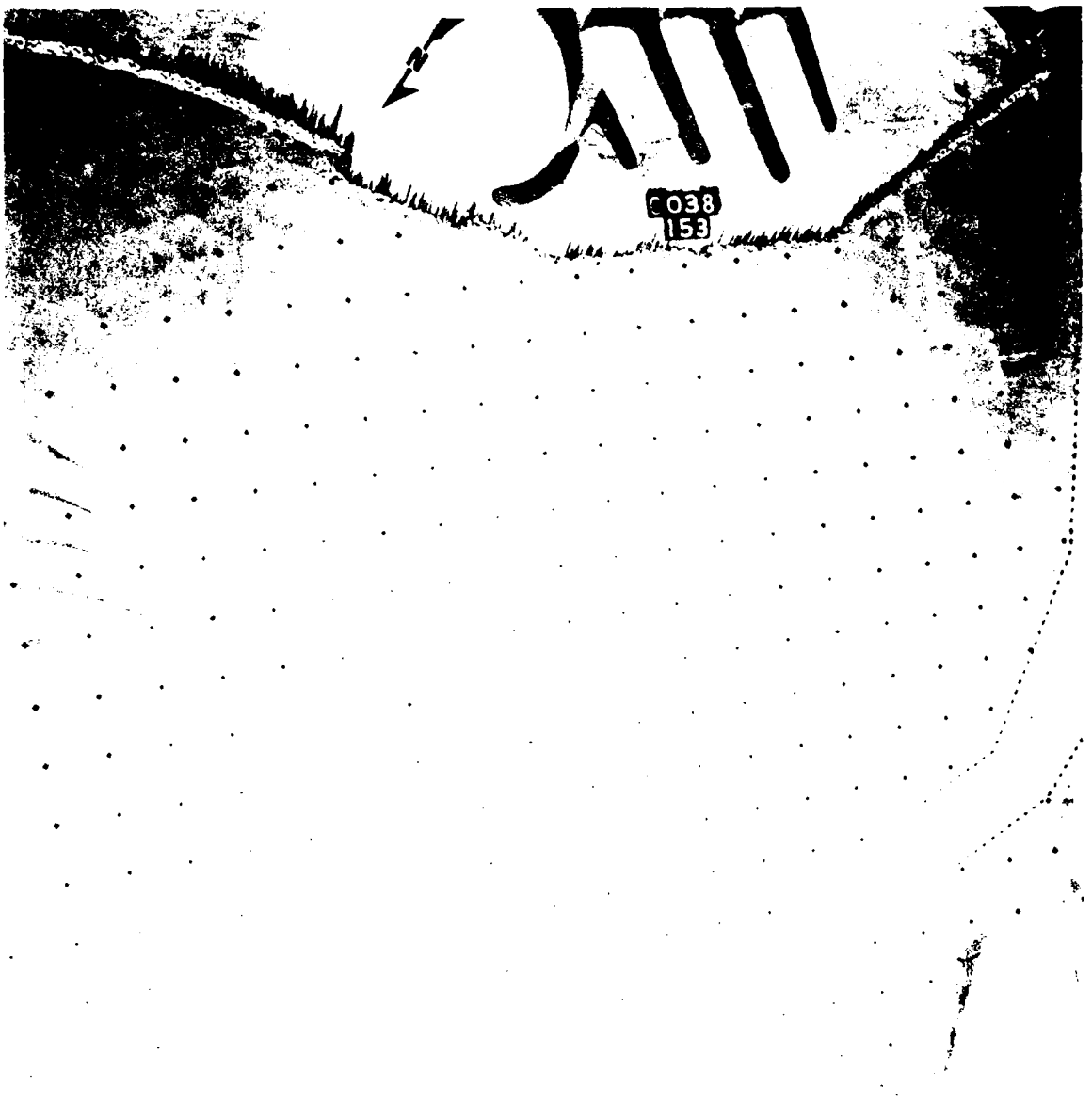

Photo 27. Typical wave patterns approaching Buhne Point for 11-sec, 10-ft waves from west; 0.0-ft swl

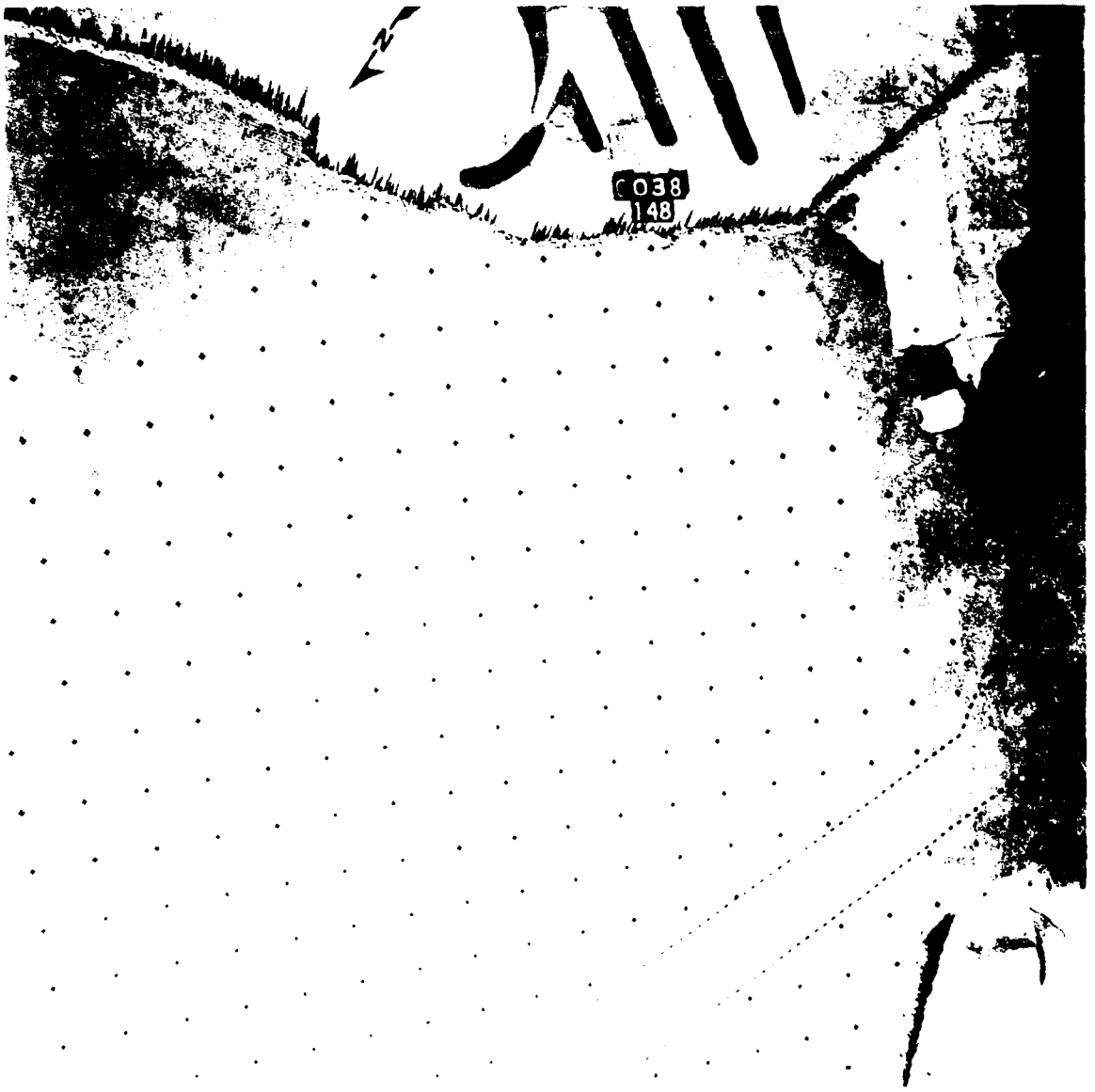

Photo 26. Typical wave patterns approaching Buhne Point for 5-sec, 7-ft waves from west; 0.0-ft swl

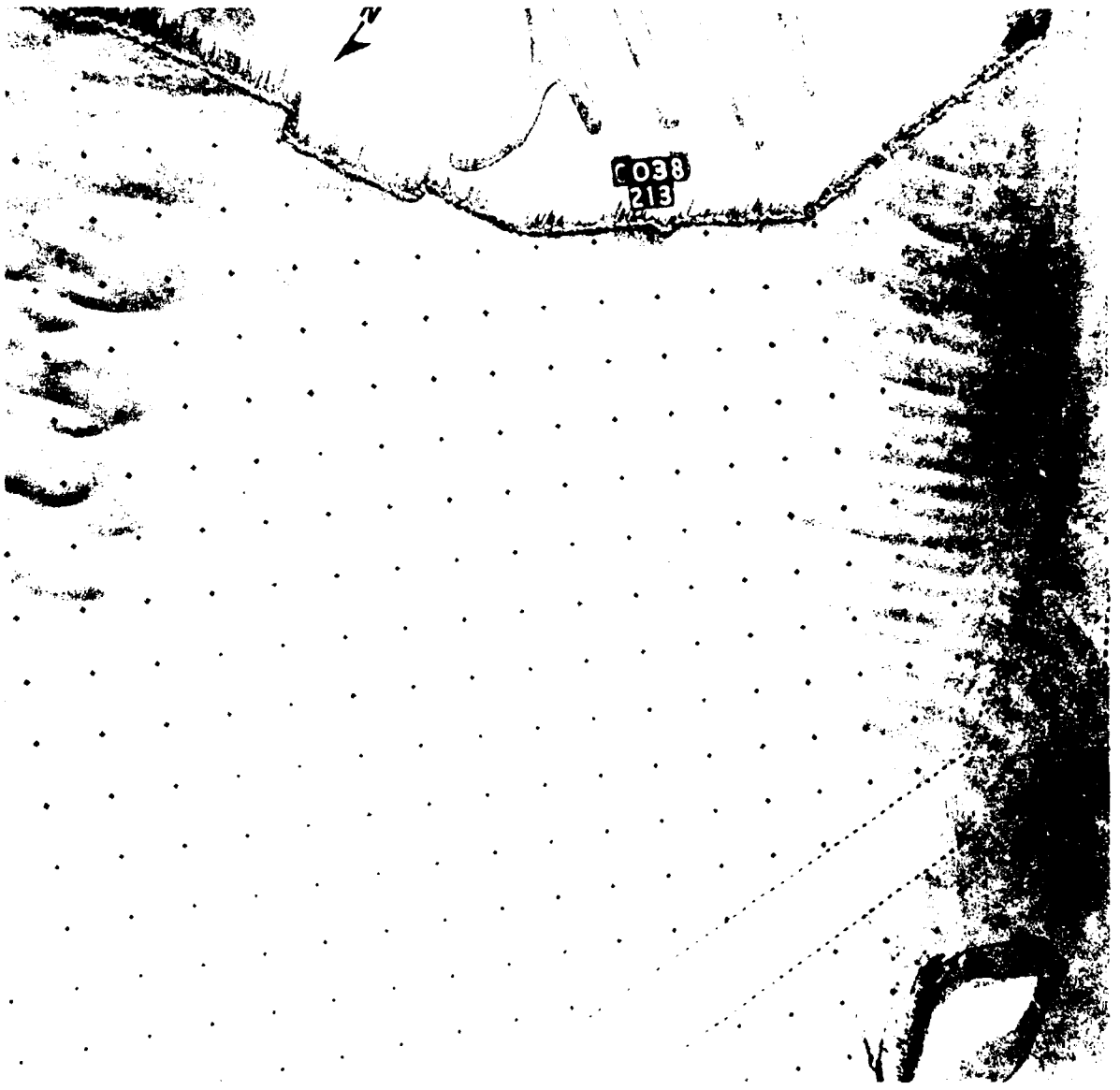

Photo 40. Typical wave patterns approaching Buhne Point for 15-sec, 11-ft waves from west; +9.5 ft swl

Photo 41. Typical wave patterns, current patterns, and current magnitudes (prototype feet per sec) for existing conditions; 9-sec, 19-ft waves from northwest; 0.0-ft SWL

Photo 42. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 11-sec, 10-ft waves from northwest; 0.0-ft swl

Photo 43. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 13-sec, 22-ft waves from northwest; 0.0-ft swl

Photo 44. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 15-sec, 9-ft waves from northwest; 0.0-ft swl

Photo 45. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 17-sec, 8-ft waves from northwest; 0.0-ft swl

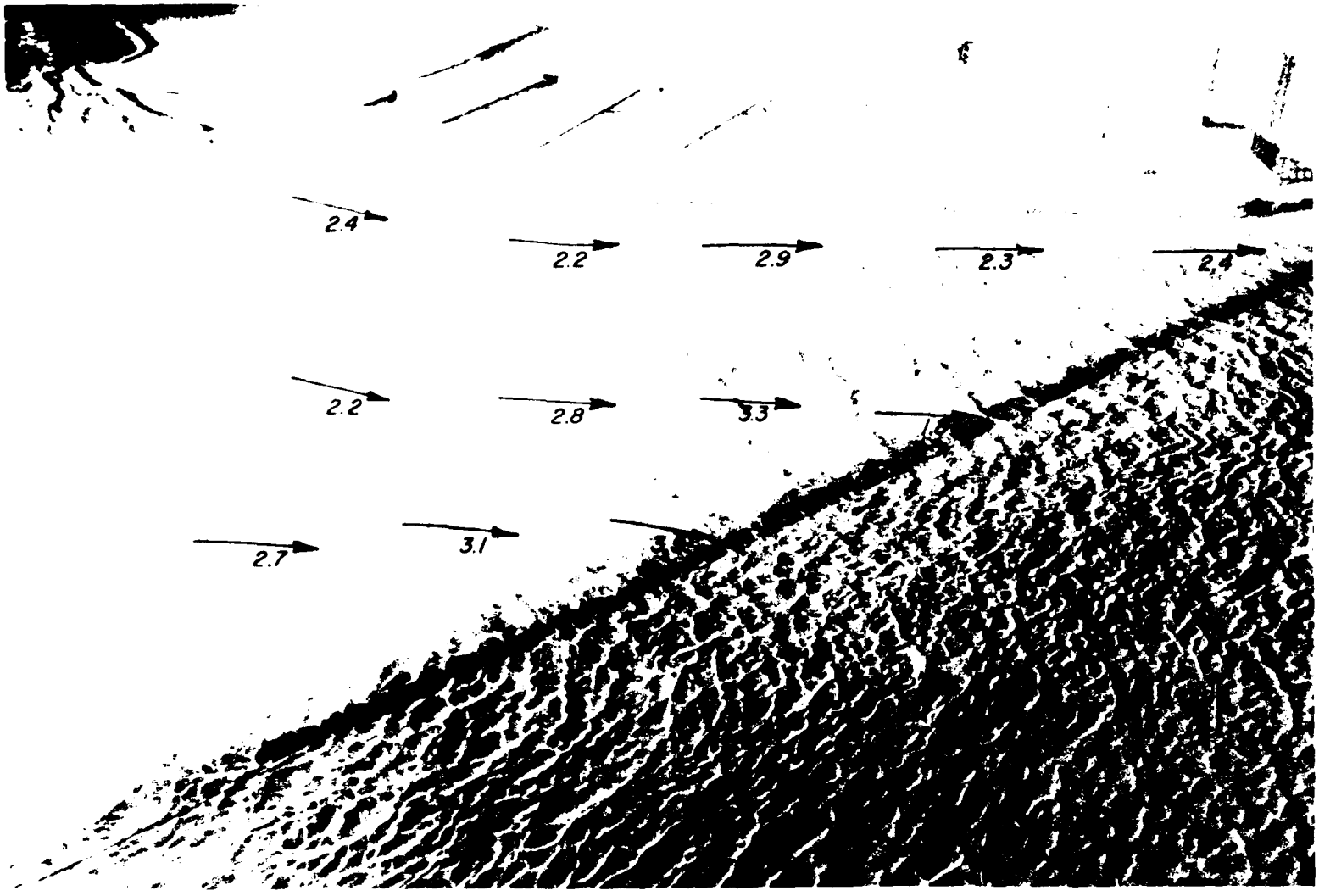

Photo 46. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 9-sec, 19-ft waves from northwest for maximum flood; +3.2 ft swl

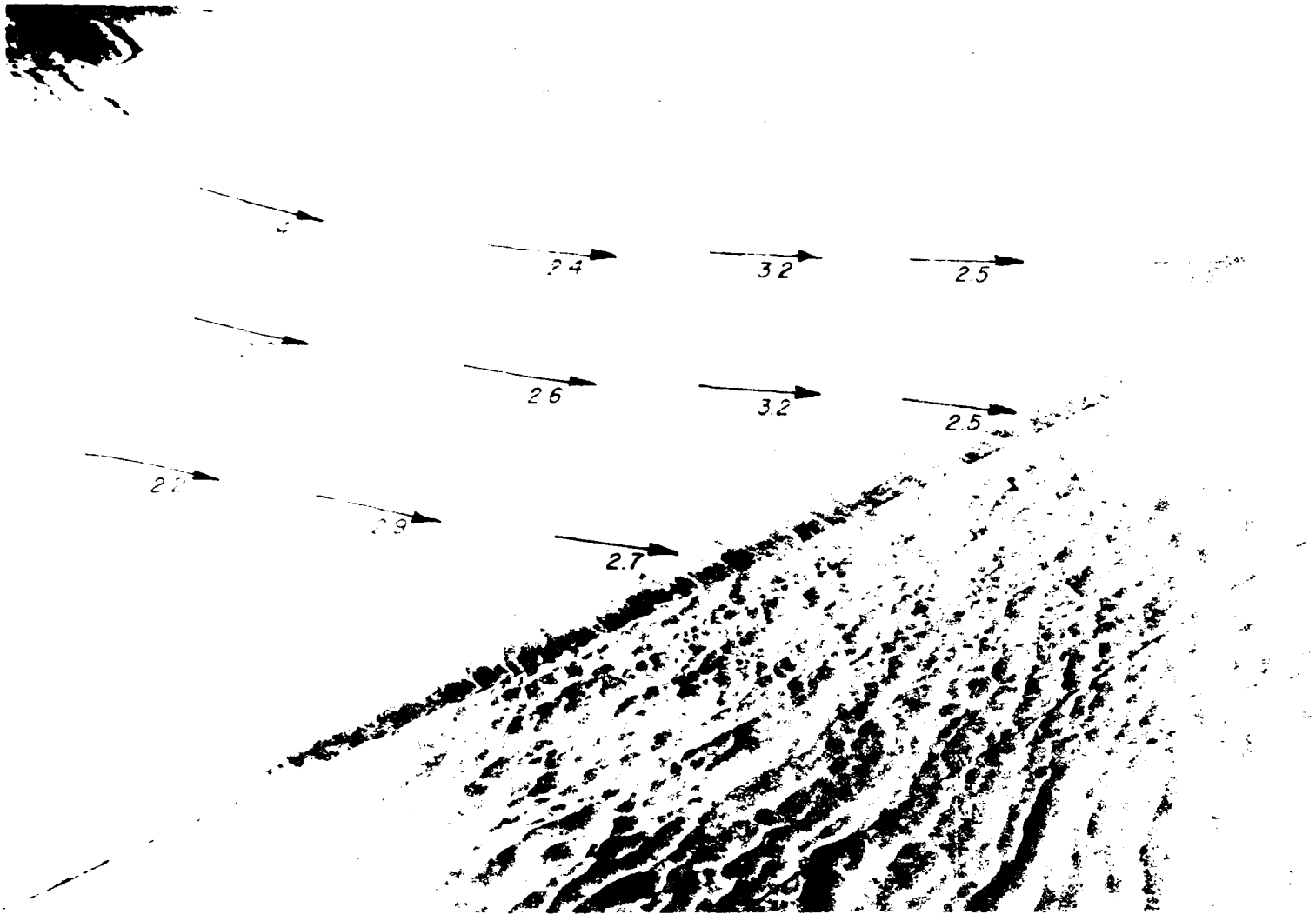

Photo 47. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 11-sec, 10-ft waves from northwest for maximum flood; [illegible]

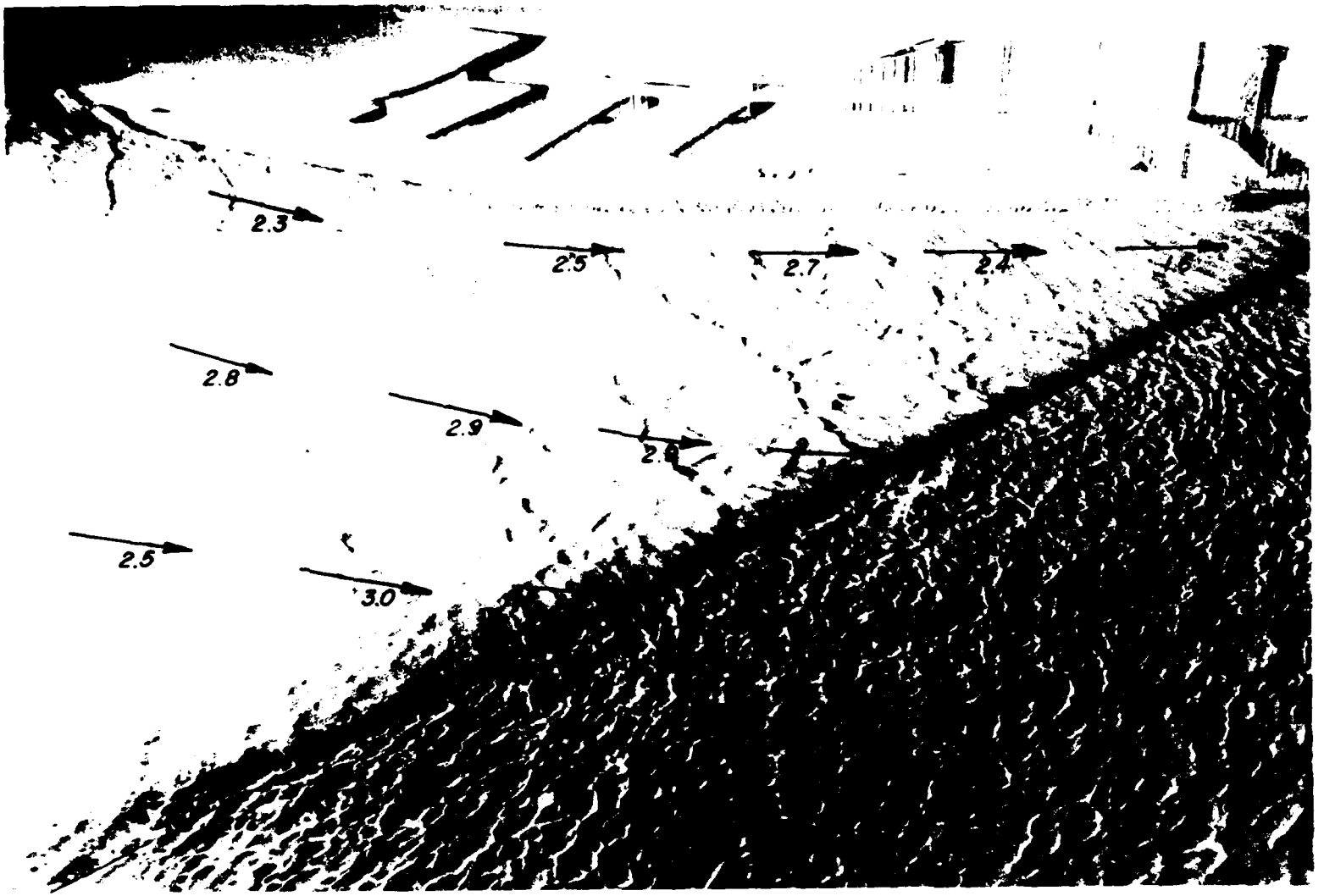

Photo 48. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 13-sec, 22-ft waves from northwest for maximum flood; +3.2 ft swl

Photo 49. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 15-sec, 9-ft waves from northwest for maximum flood; +1.2 ft SWL

Photo 50. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 17-sec, 8-ft waves from northwest for maximum flood; +3.2 ft swl

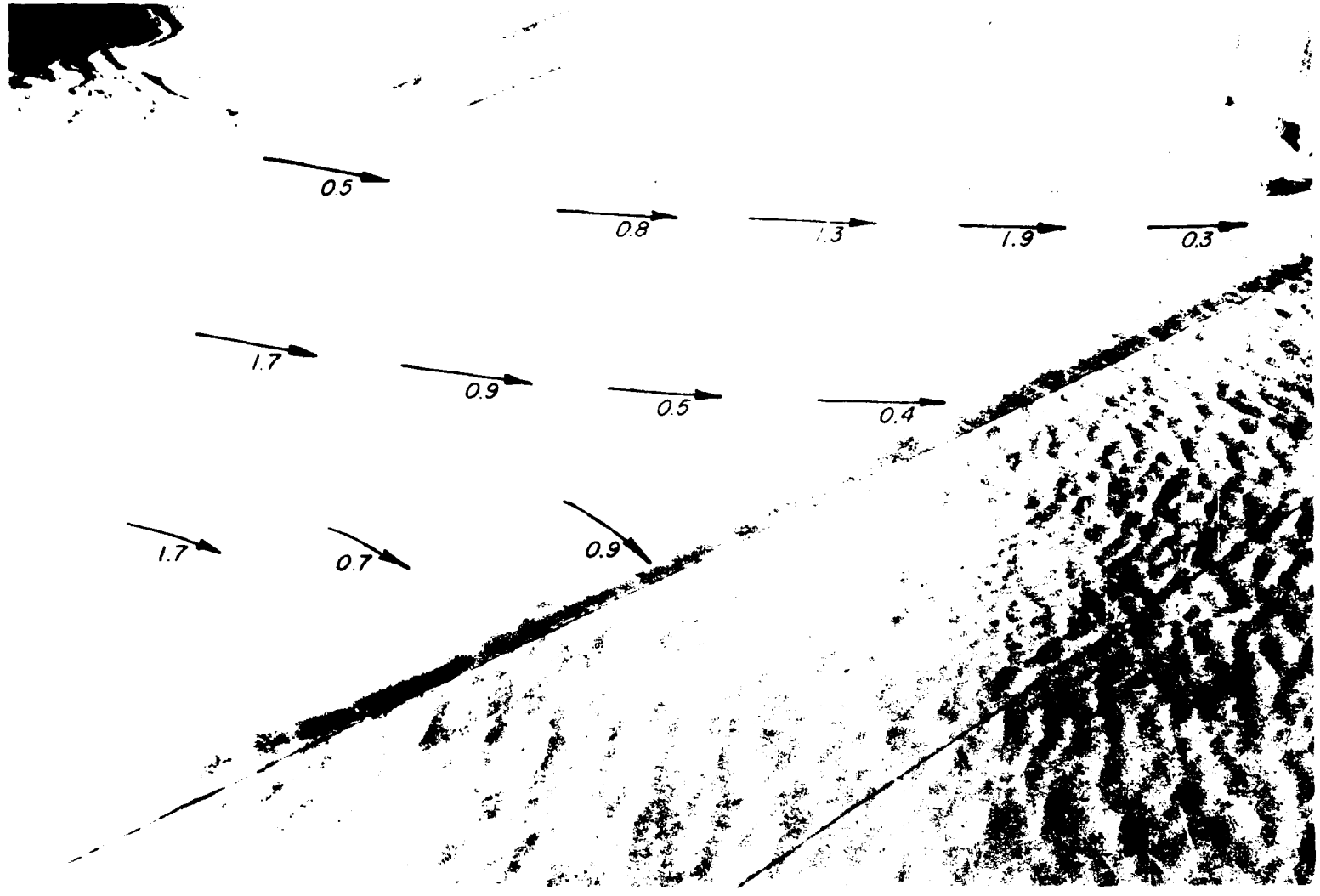

Photo 51. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 9-sec, 19-ft waves from northwest for maximum ebb; +3.7 ft swl

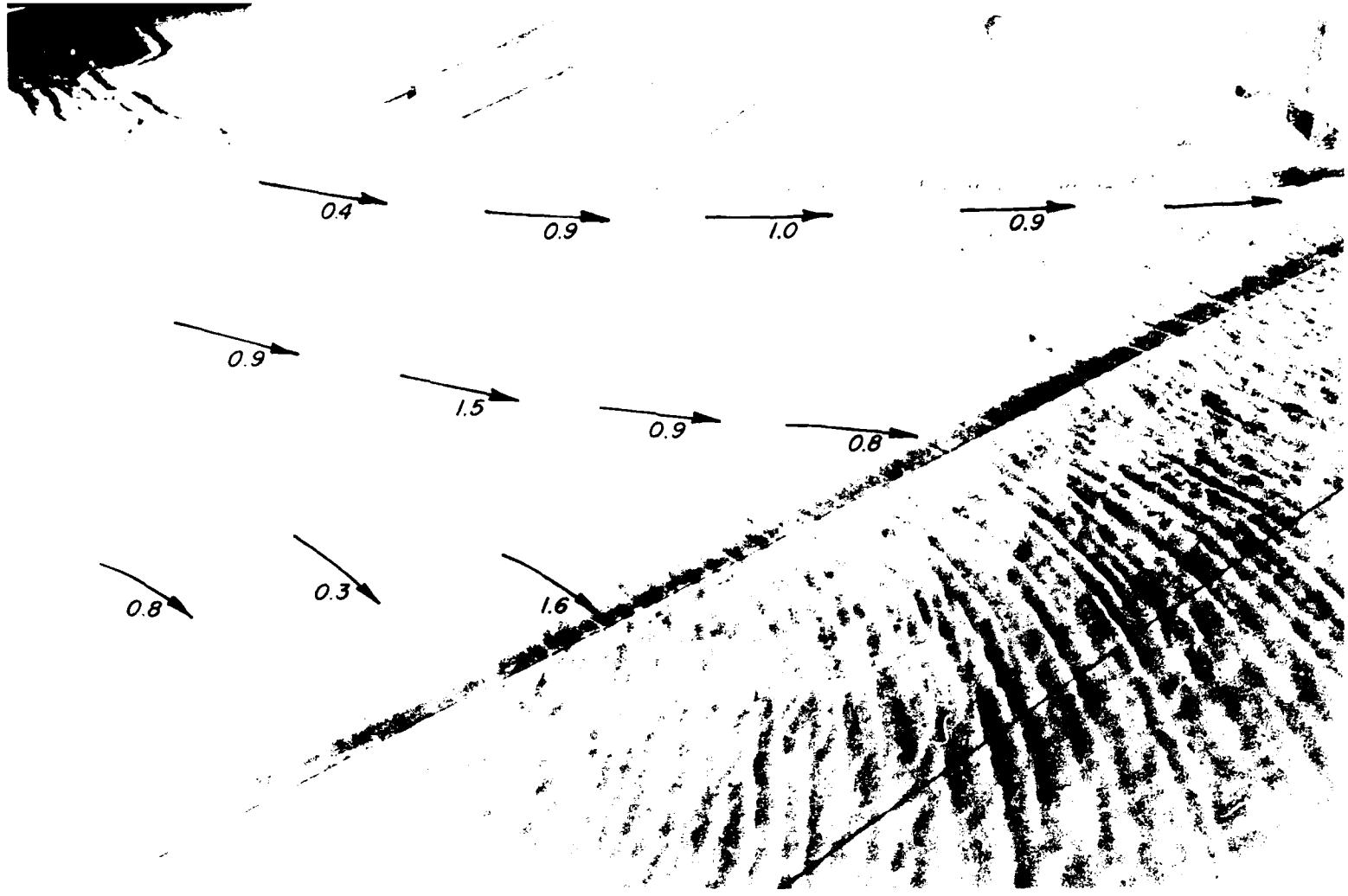

Photo 52. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 11-sec, 10-ft waves from northwest for maximum ebb; +3.7 ft swl

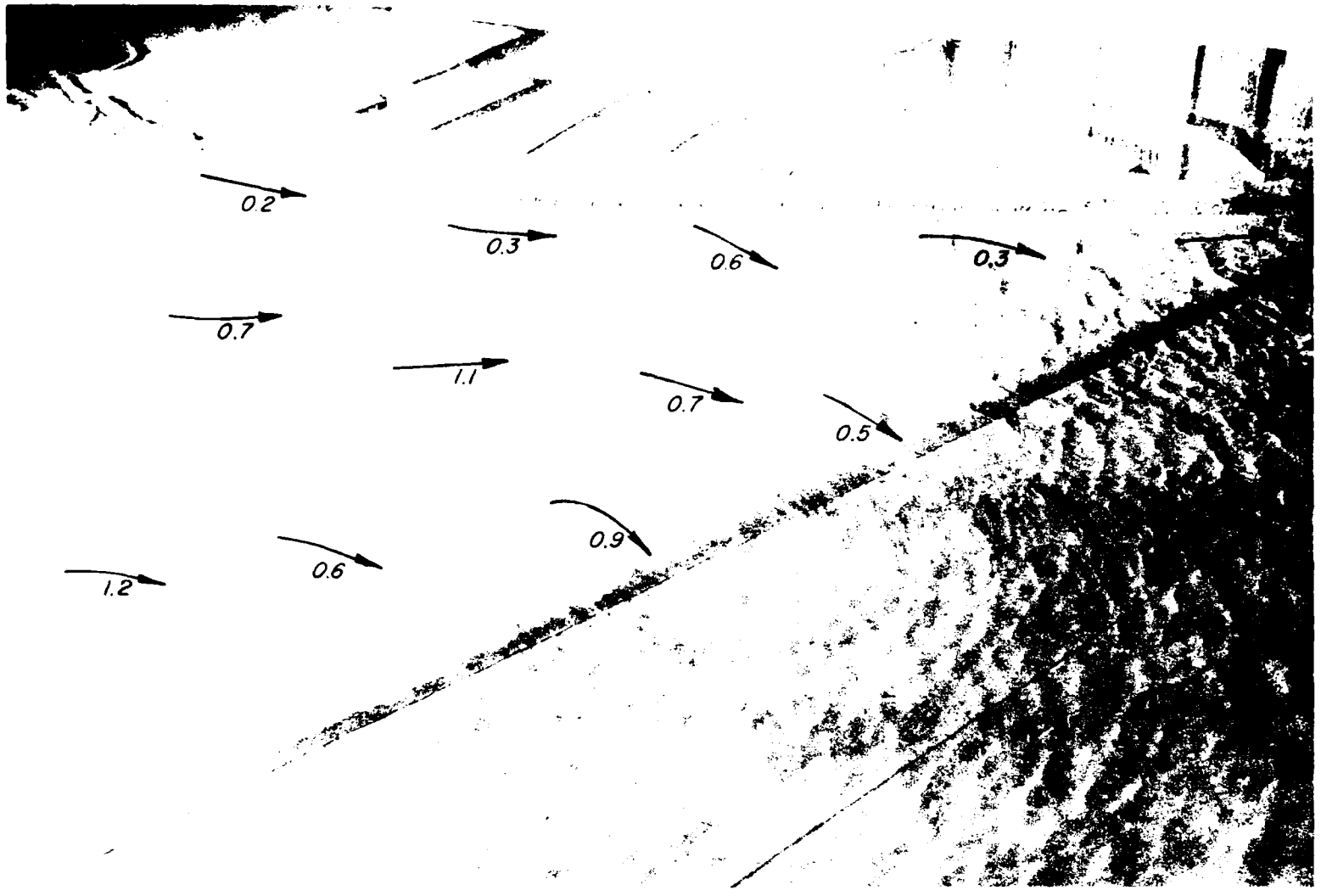

Photo 53. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 13-sec, 22-ft waves from northwest for maximum ebb; +3.7 ft swl

Photo 67. General movement of tracer material and deposits resulting from 11-sec, 10-ft waves for maximum ebb for simulated 1983 conditions; +3.7 ft swl

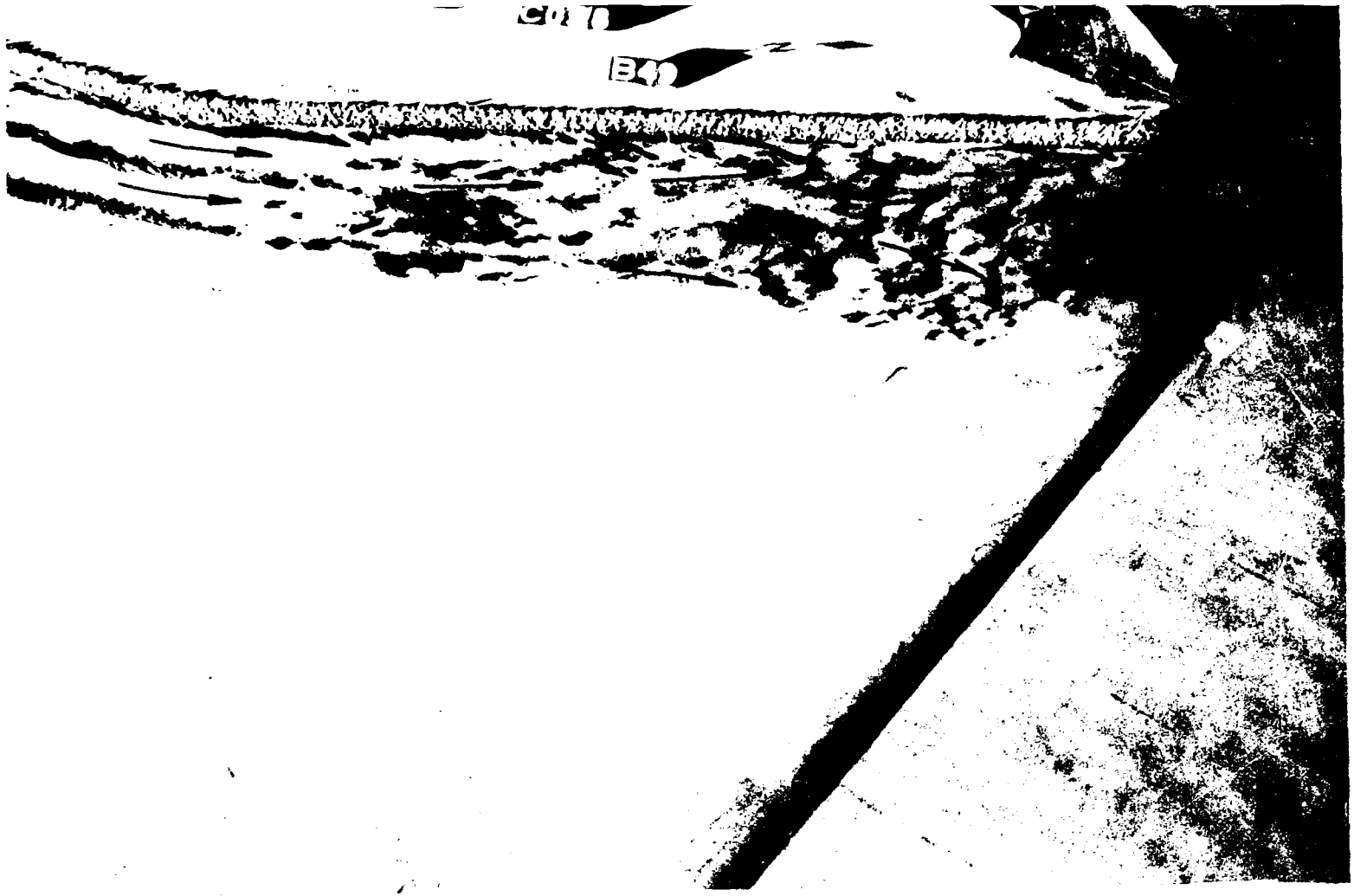

Photo 66. General movement of tracer material and deposits resulting from 11-sec, 10-ft waves for maximum flood for simulated 1983 conditions; +3.2 ft swl

Photo 65. Typical wave patterns, current patterns, and current magnitudes (prototype feet per sec) for existing conditions; 17-sec, 8-ft waves from northwest; +9.5 ft swl

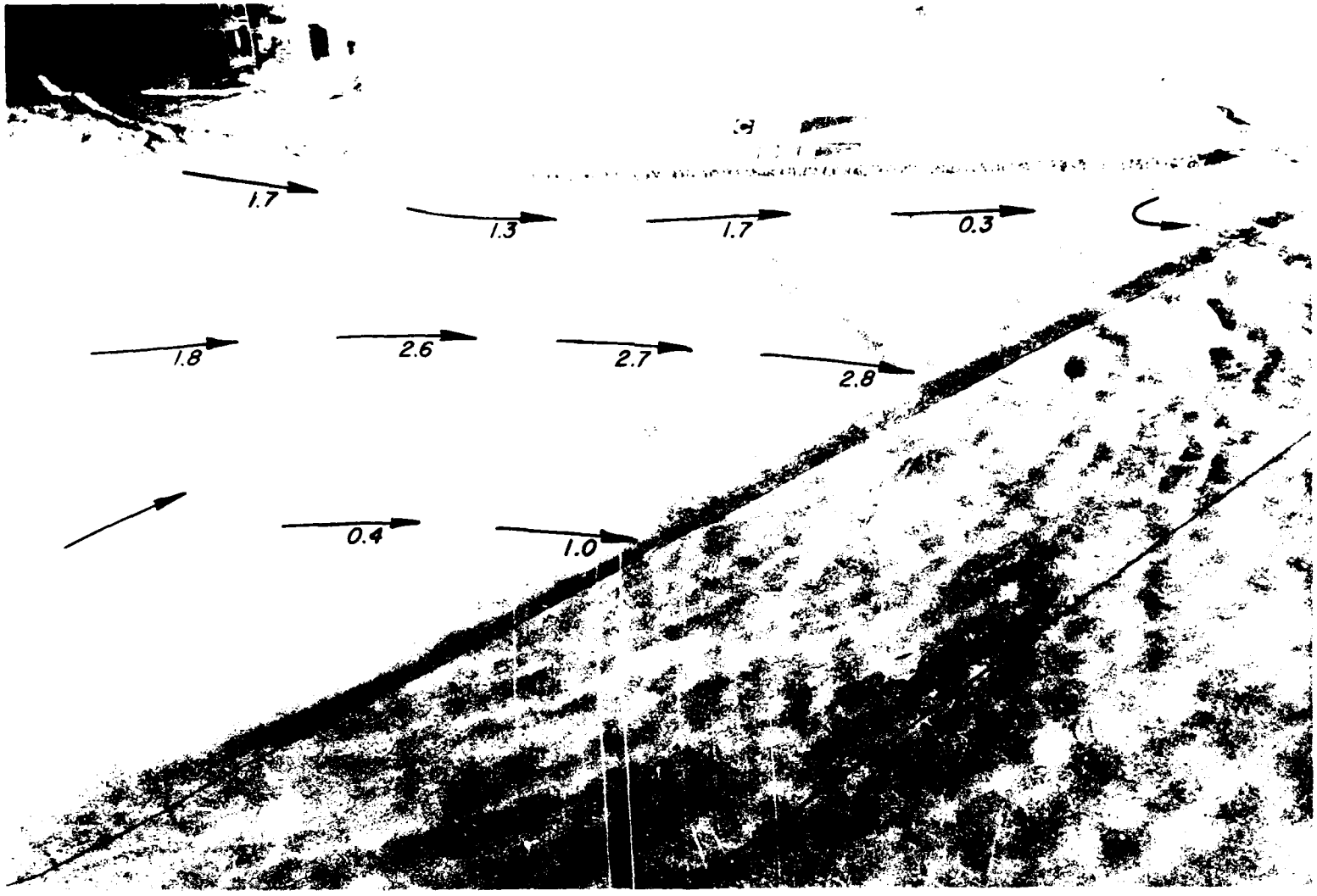

Photo 64. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 15-sec, 9-ft waves from northwest; +9.5 ft swl

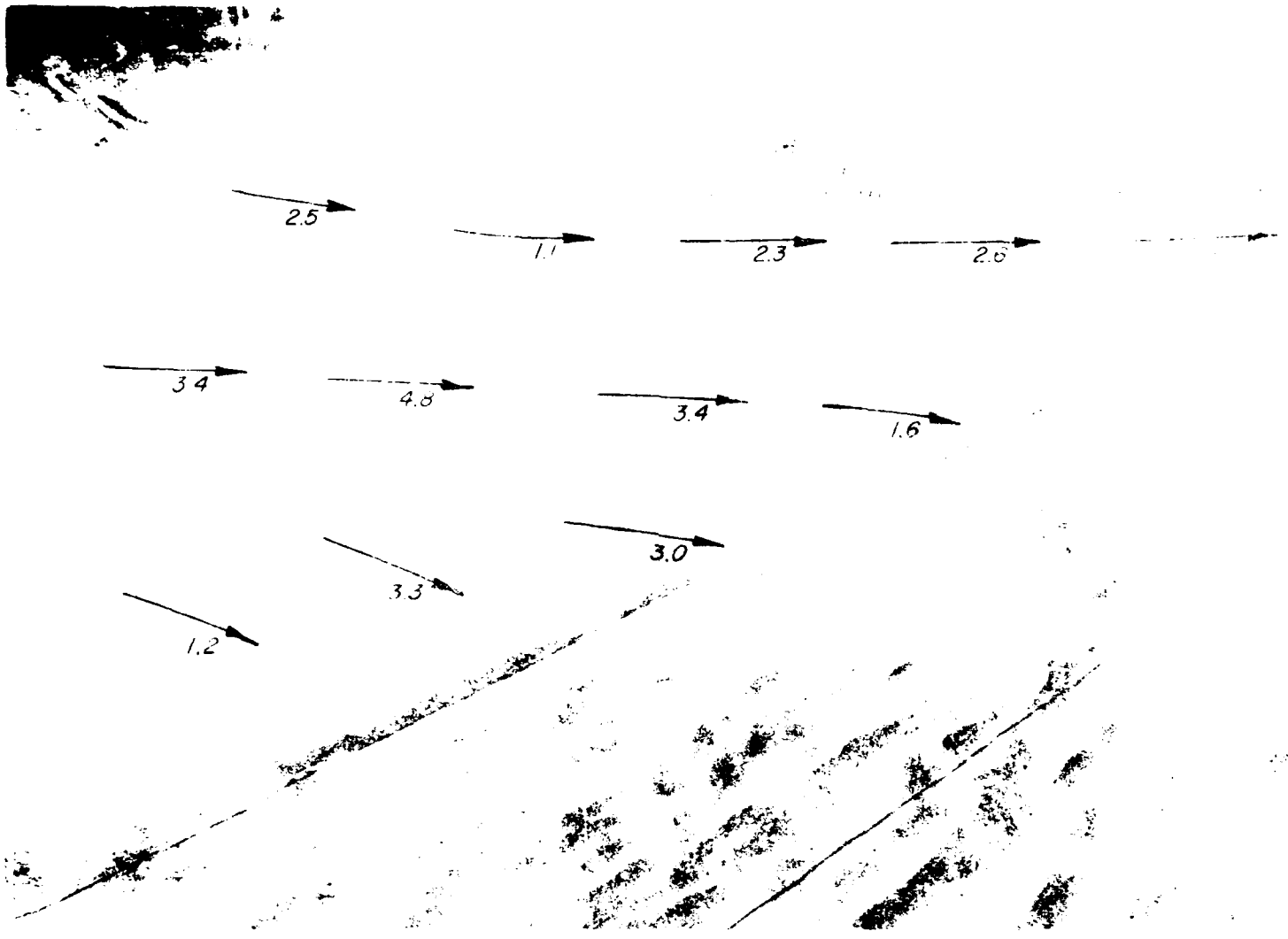

Photo 63. Typical wave patterns, current patterns, and current magnitudes (prototype [illegible] for existing conditions; 13-sec, 22-ft waves from northwest; [illegible] ft [illegible]

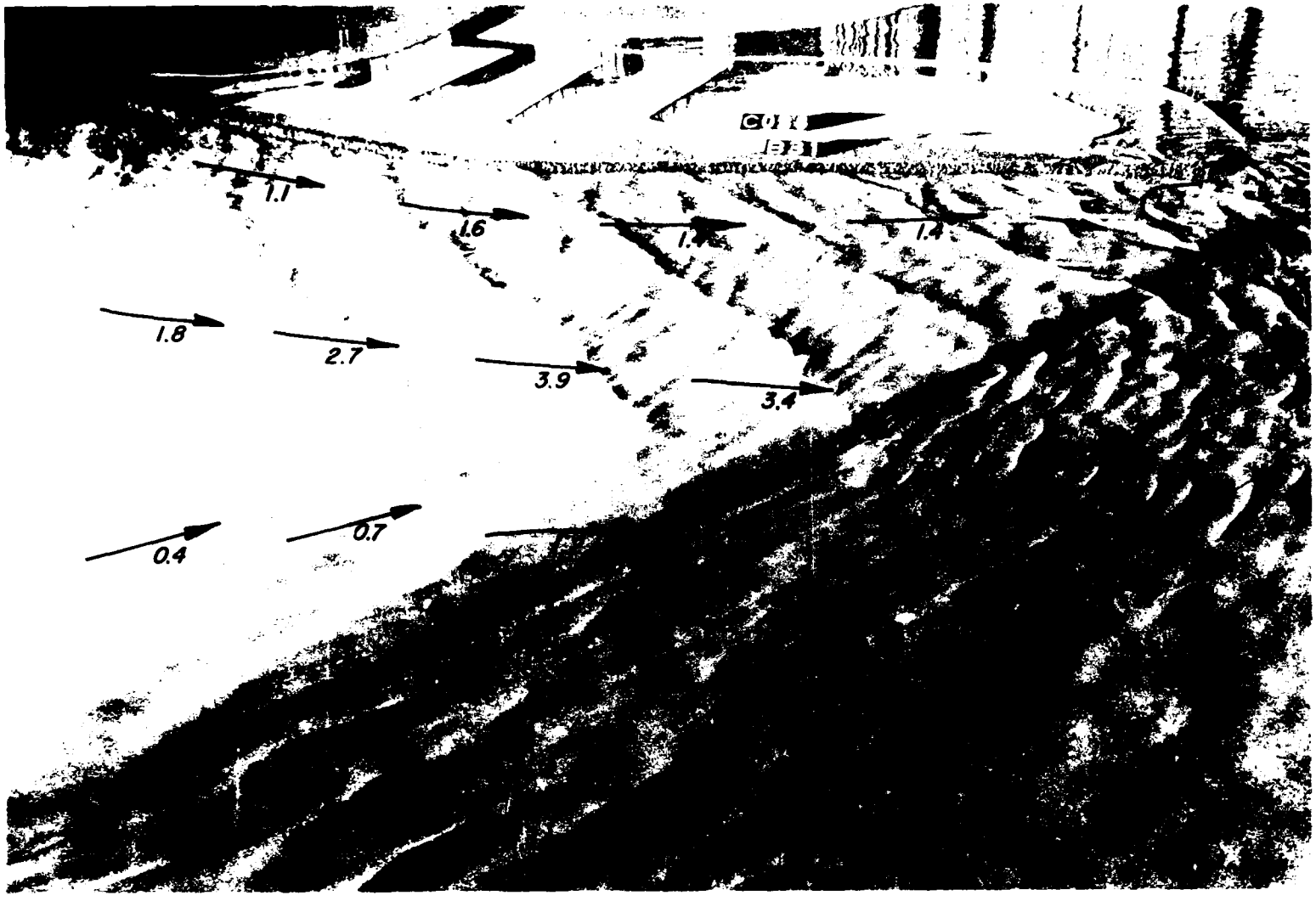

Photo 62. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 11-sec, 10-ft waves from northwest; +9.5 ft swl

Photo 61. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 9-sec, 19-ft waves from northwest; +9.5 ft swl

Photo 60. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 17-sec, 8-ft waves from northwest; +6.7 ft swl

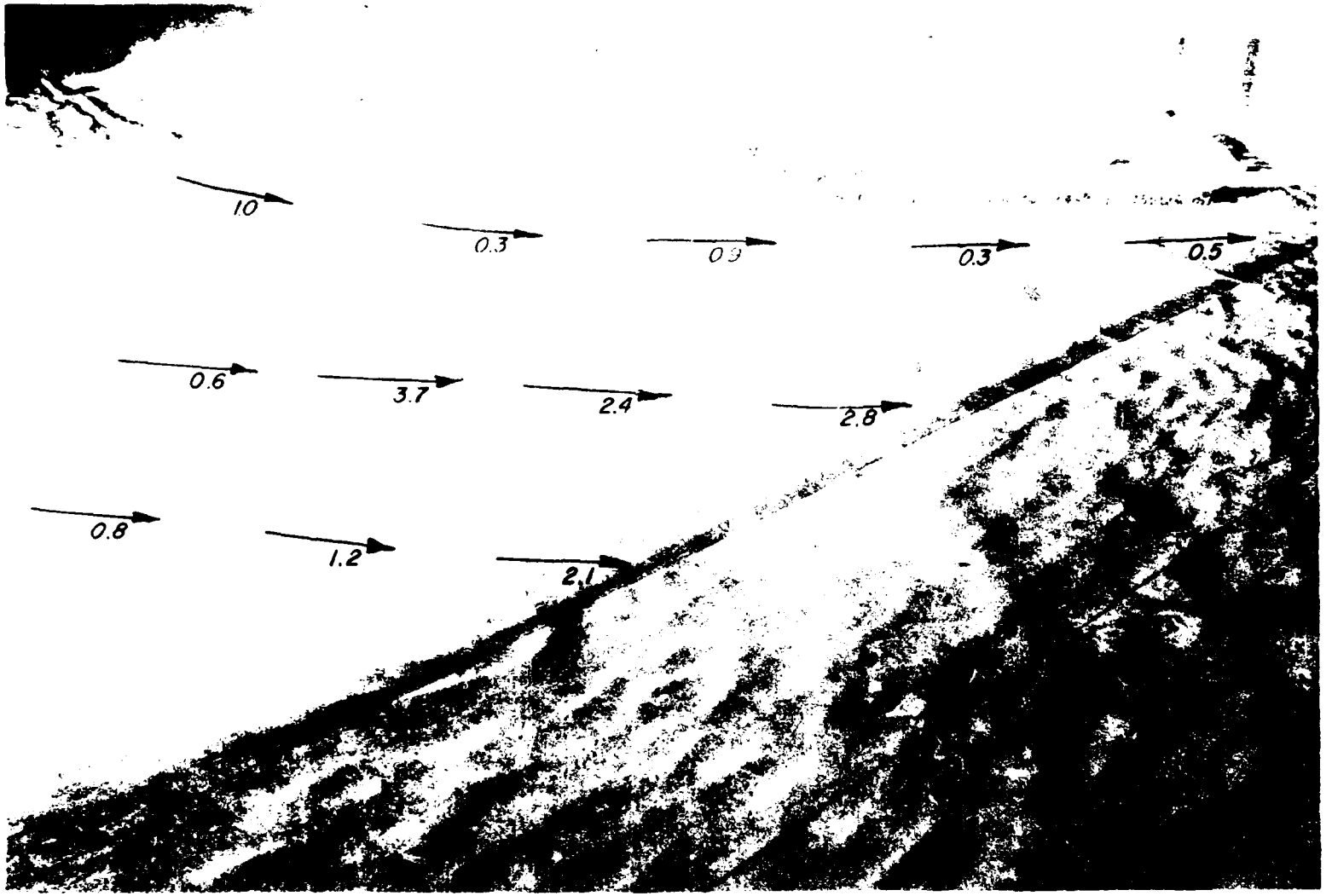

Photo 59. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 15-sec, 9-ft waves from northwest; +6.7 ft swl

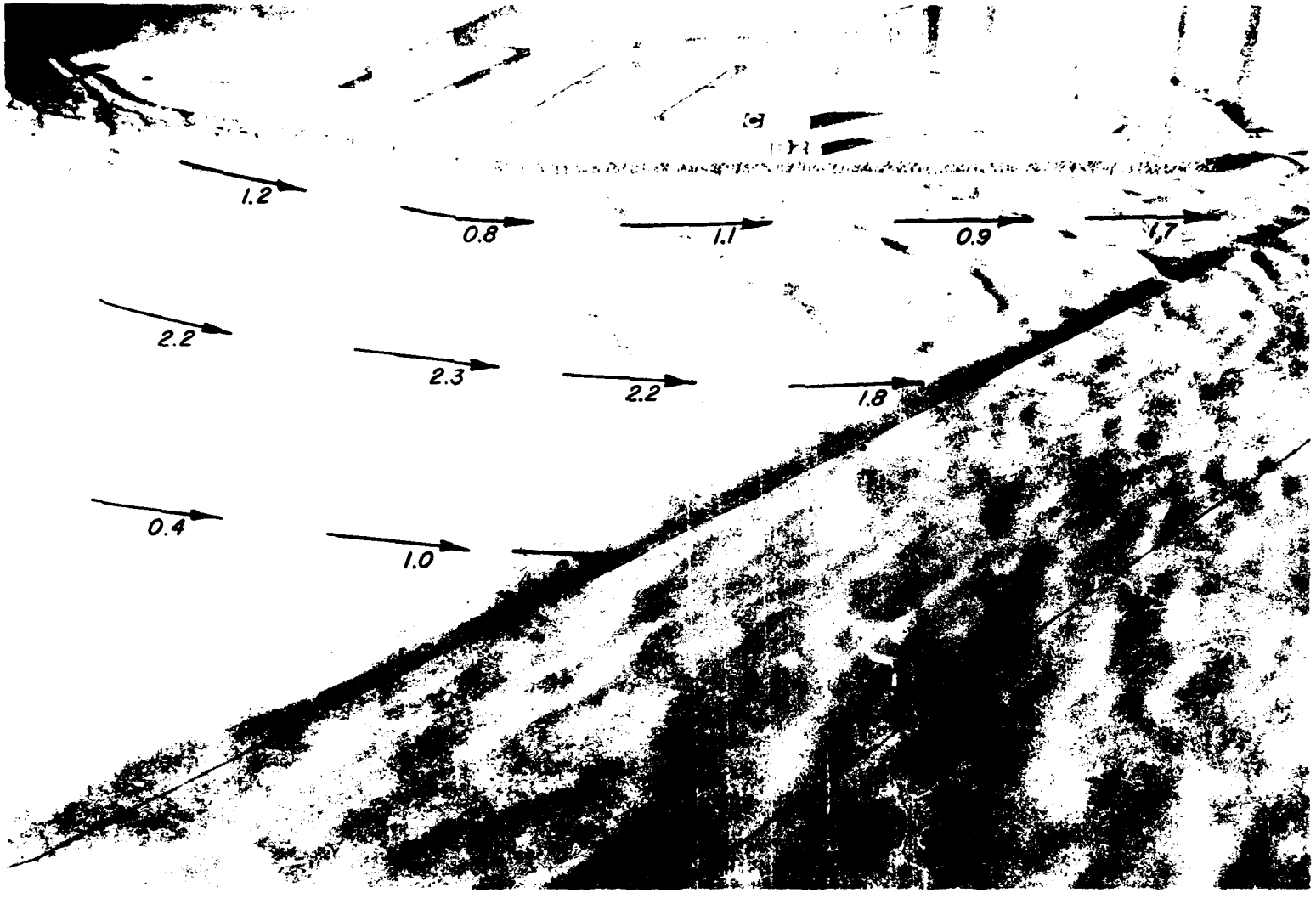

Photo 58. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 13-sec, 22-ft waves from northwest; +6.7 ft swl

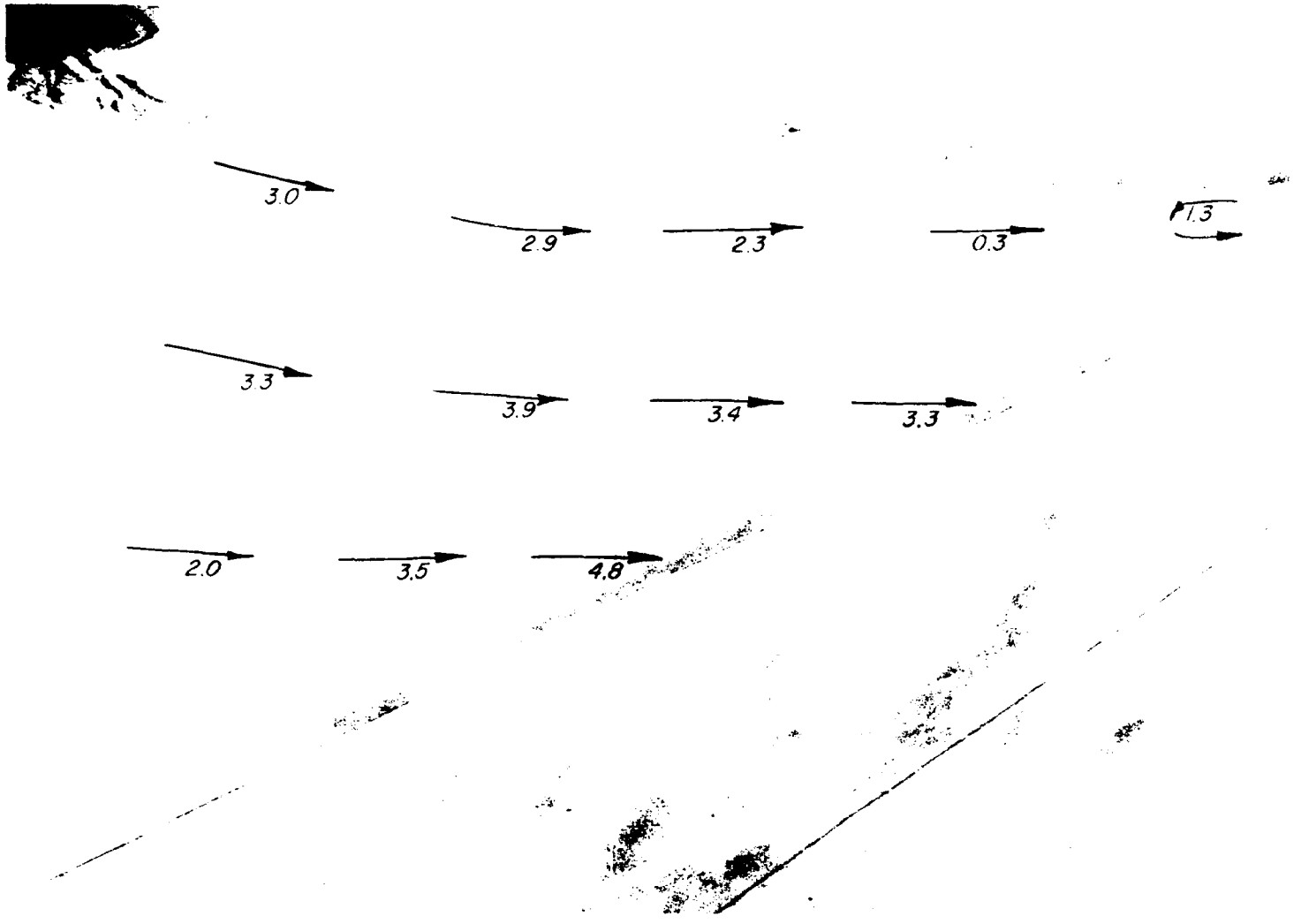

Photo 57. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 11-sec, 10-ft waves from northwest; +6.7 ft swl

Photo 56. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 9-sec, 19-ft waves from northwest; +6.7 ft swl

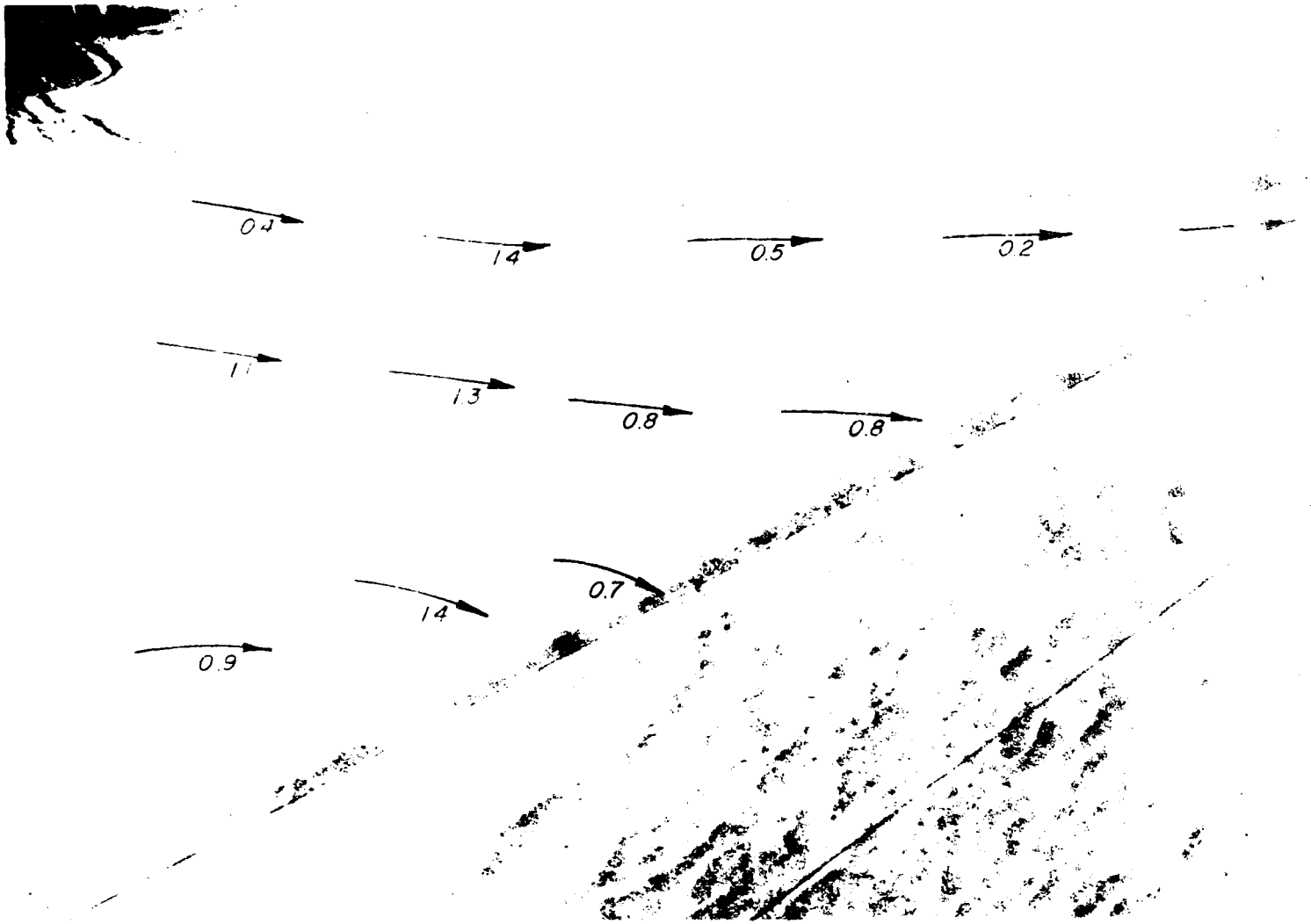

Photo 55. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 17-sec, 8-ft waves from northwest for maximum ebb; +3.7 ft MSL

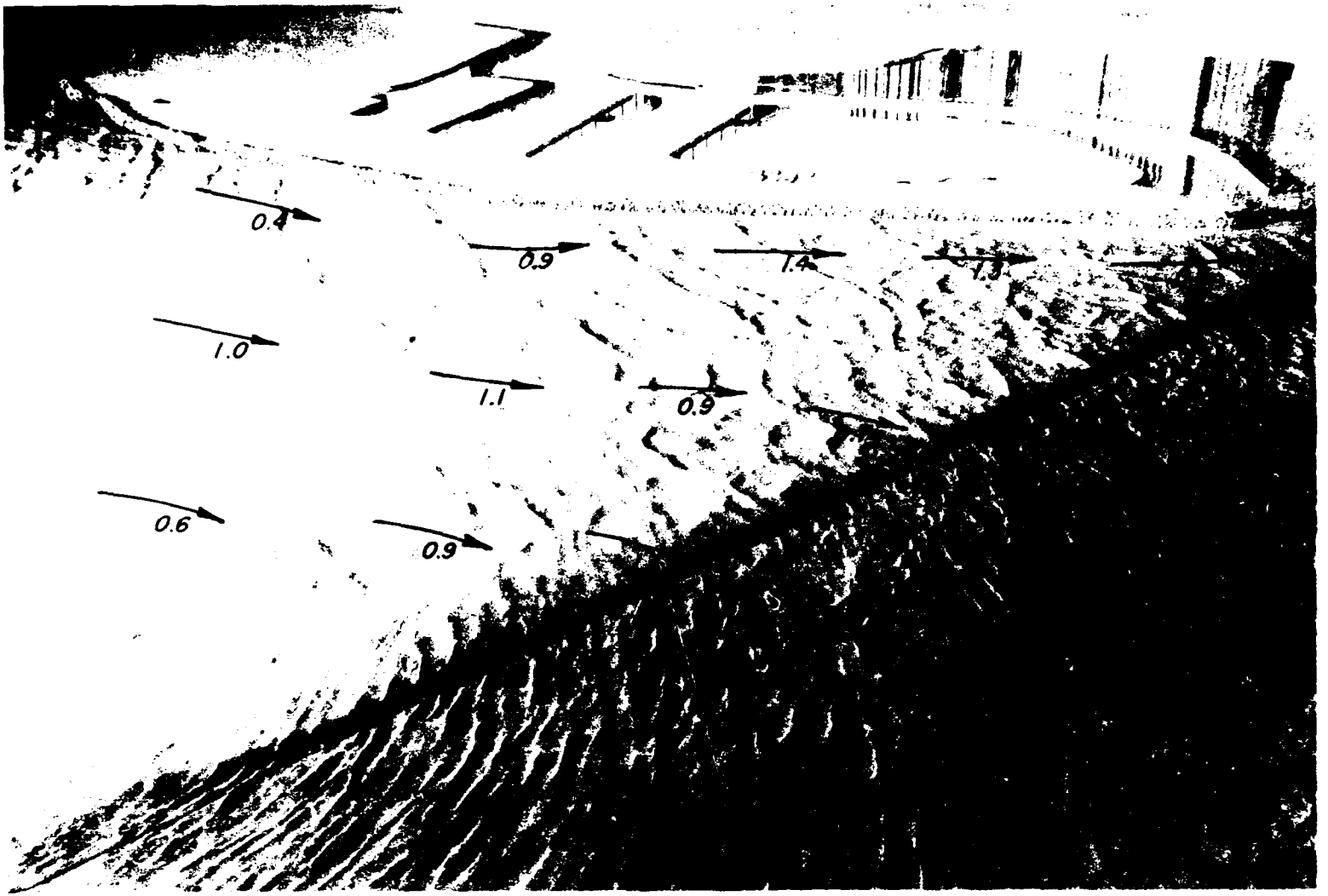

Photo 54. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for existing conditions; 15-sec, 9-ft waves from northwest for maximum ebb; +3.7 ft swl

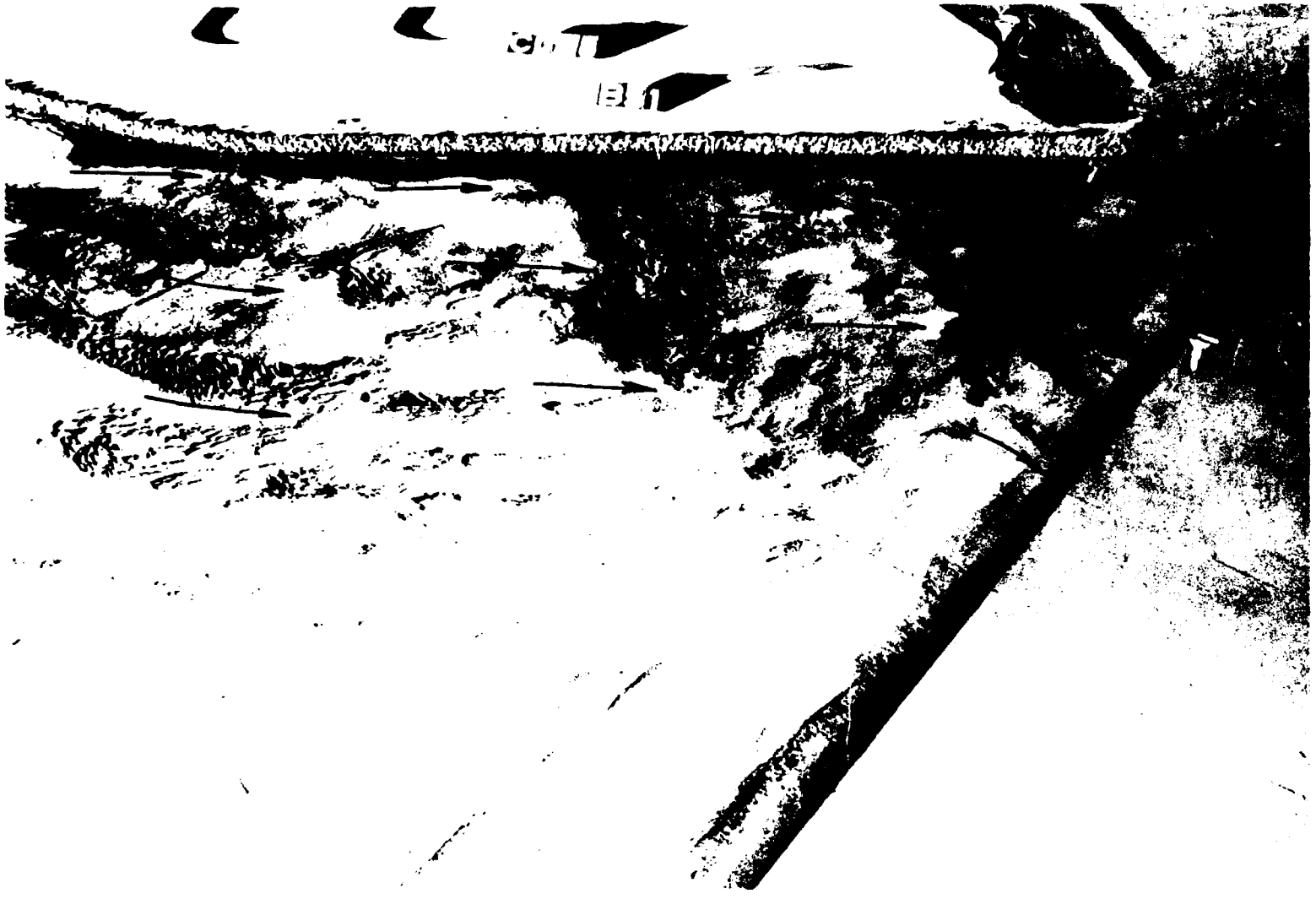

Photo 68. General movement of tracer material and deposits resulting from 11-sec, 10-ft waves for simulated 1983 conditions; +6.7 ft swl

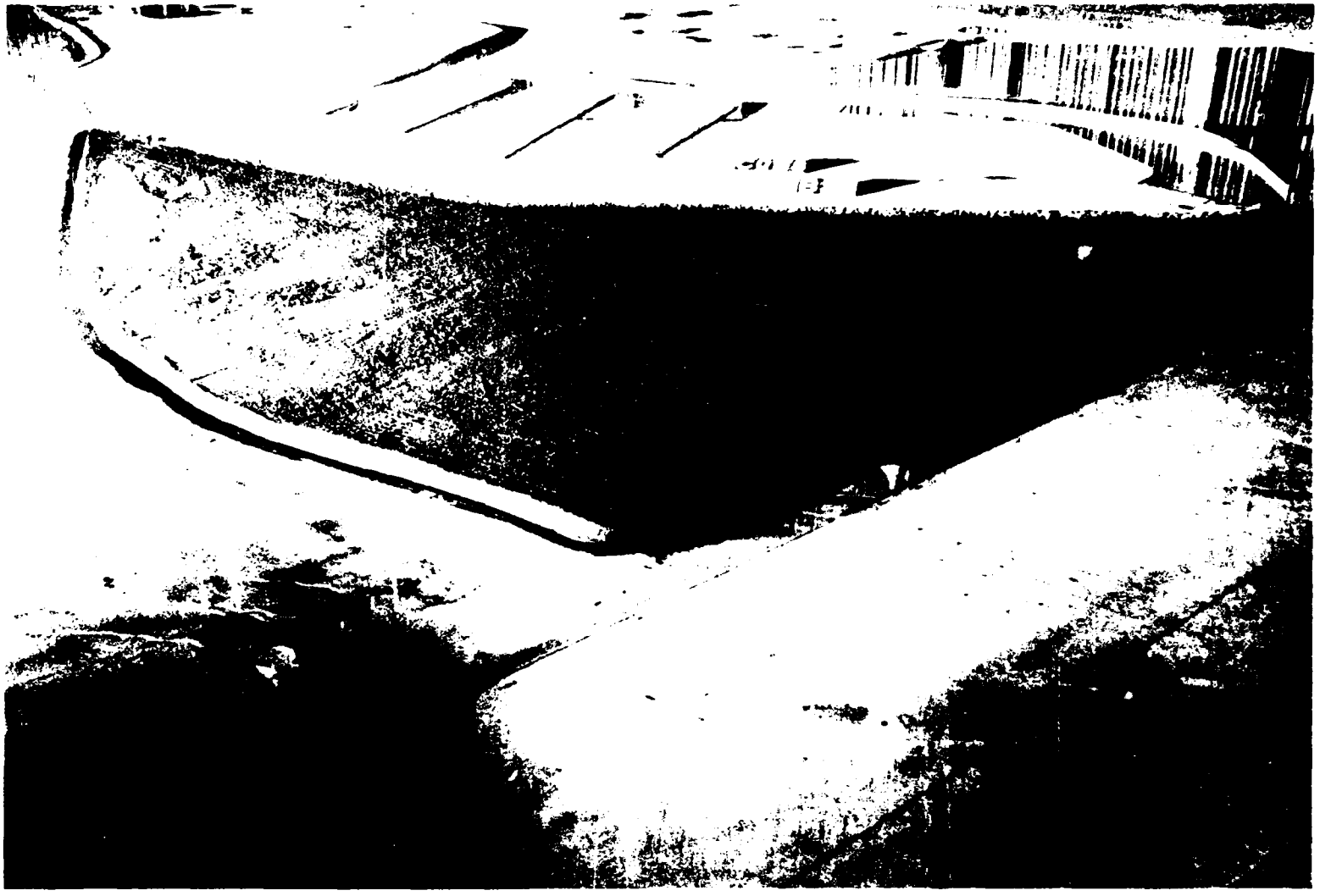

Photo 69. Placement of tracer material representing the 1966 spit formation at Buhne Point

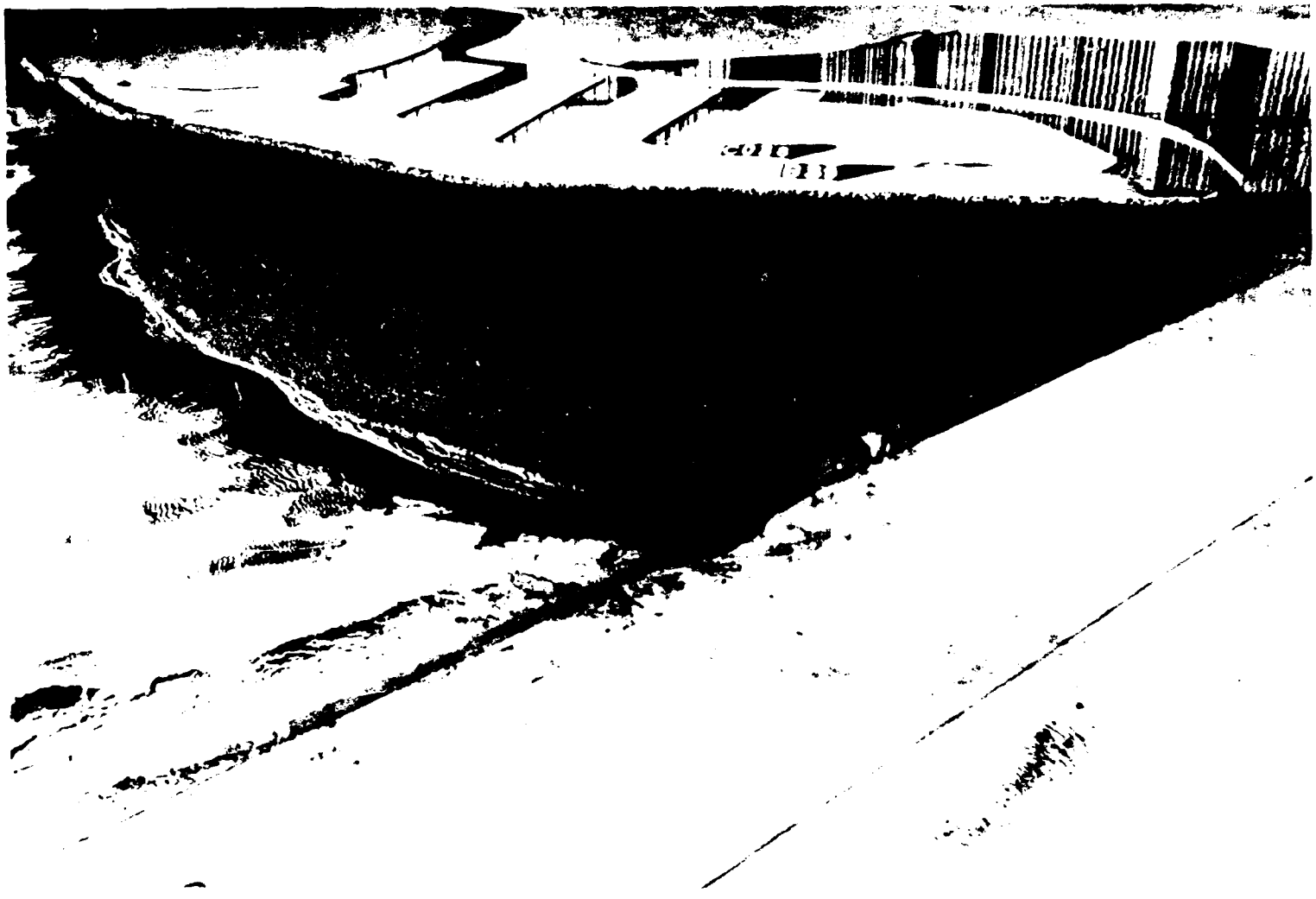

Photo 70. Initial movement of simulated 1966 spit into navigation channel by 11-sec, 10-ft waves with a +6.7 ft swl

Photo 71. The simulated 1966 spit formation after attack by 11-sec, 10-ft waves with a +9.5 ft swl

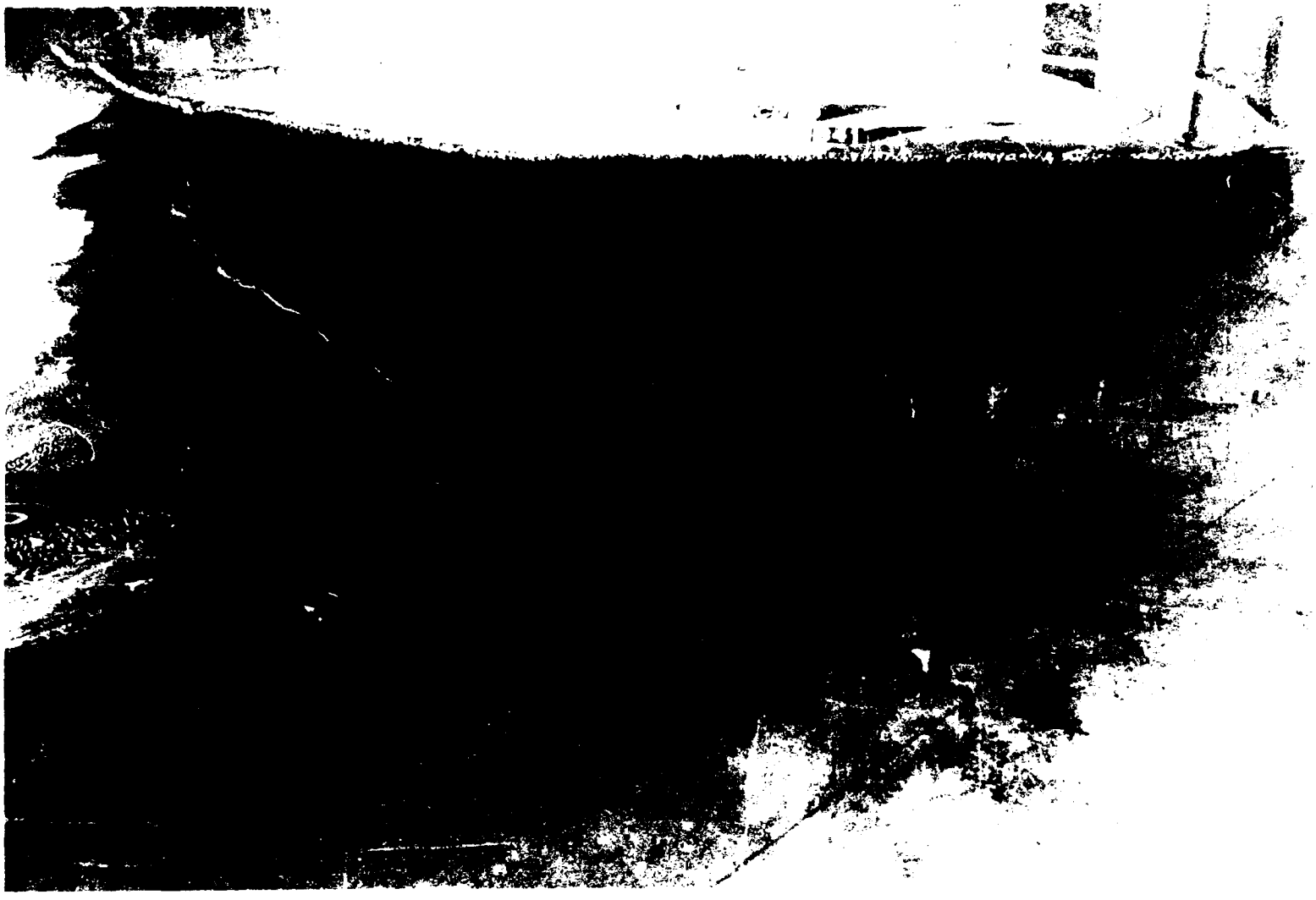

Photo 72. The simulated 1966 spit formation after attack by 13-sec, 22-ft waves with a +9.5 ft swl

Photo 23. Placement of [illegible] material representing the 1980 spit formation at [illegible]

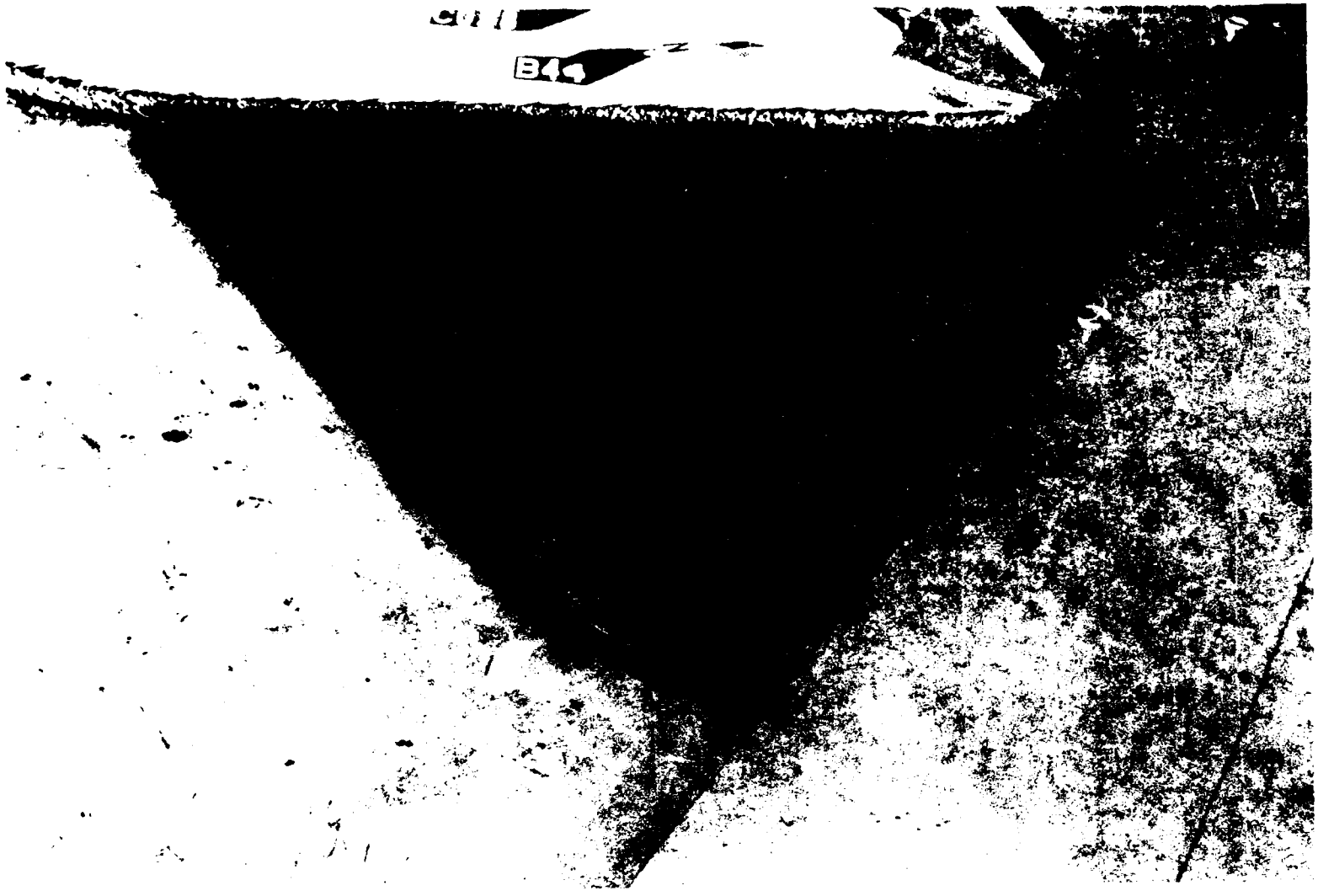

Photo 74. Closer view of tracer material representing the 1980 spit formation at Buhne Point

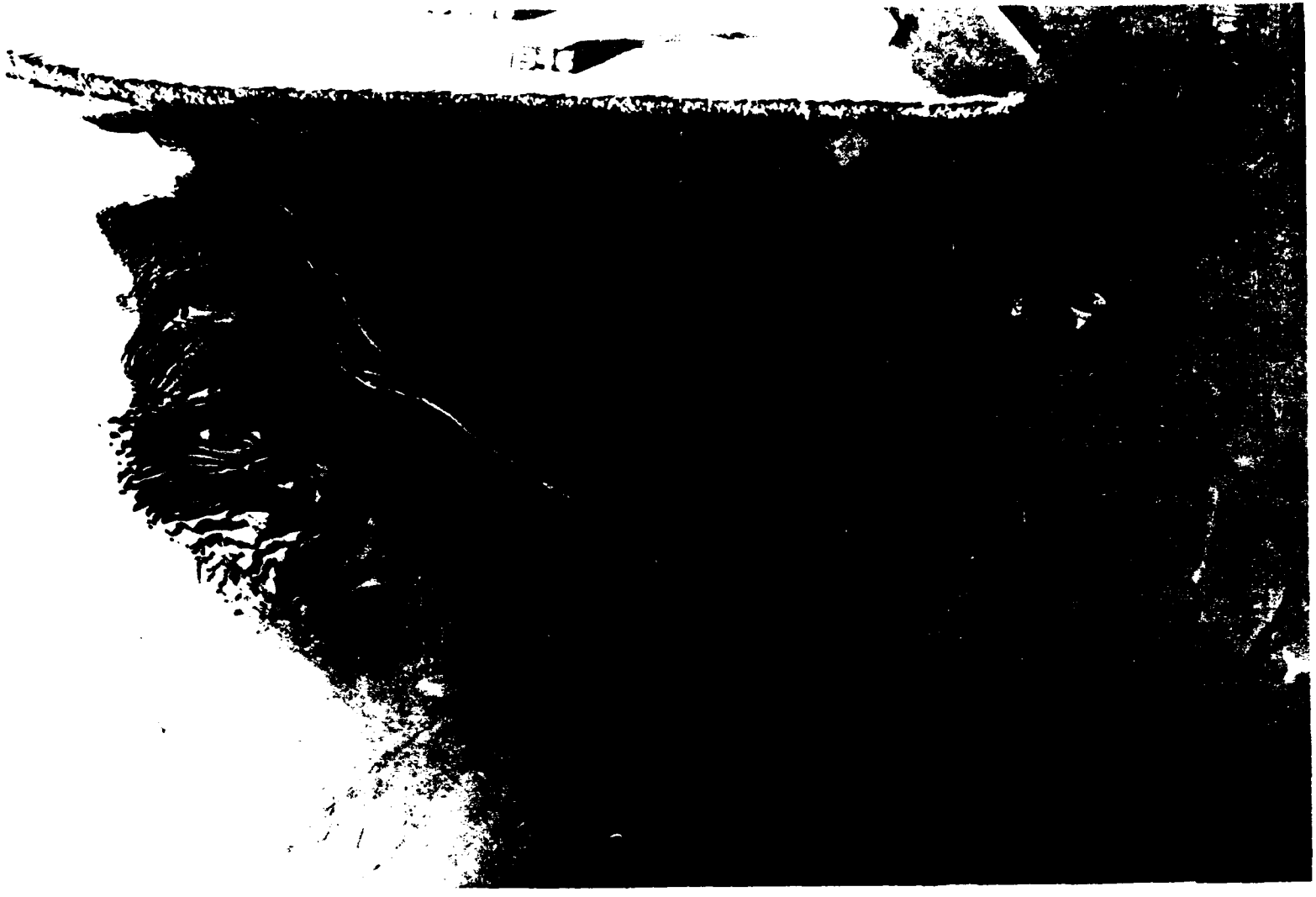

Photo 75. The simulated 1980 spit formation after attack by 11-sec, 10-ft waves with a +6.7 ft swl

Photo 76. The simulated 1980 spit formation after attack by 11-sec, 10-ft waves with a +9.5 ft swl

Photo 77. The simulated 1980 spit formation after attack by 13-sec, 22-ft waves with a +9.5 ft swl

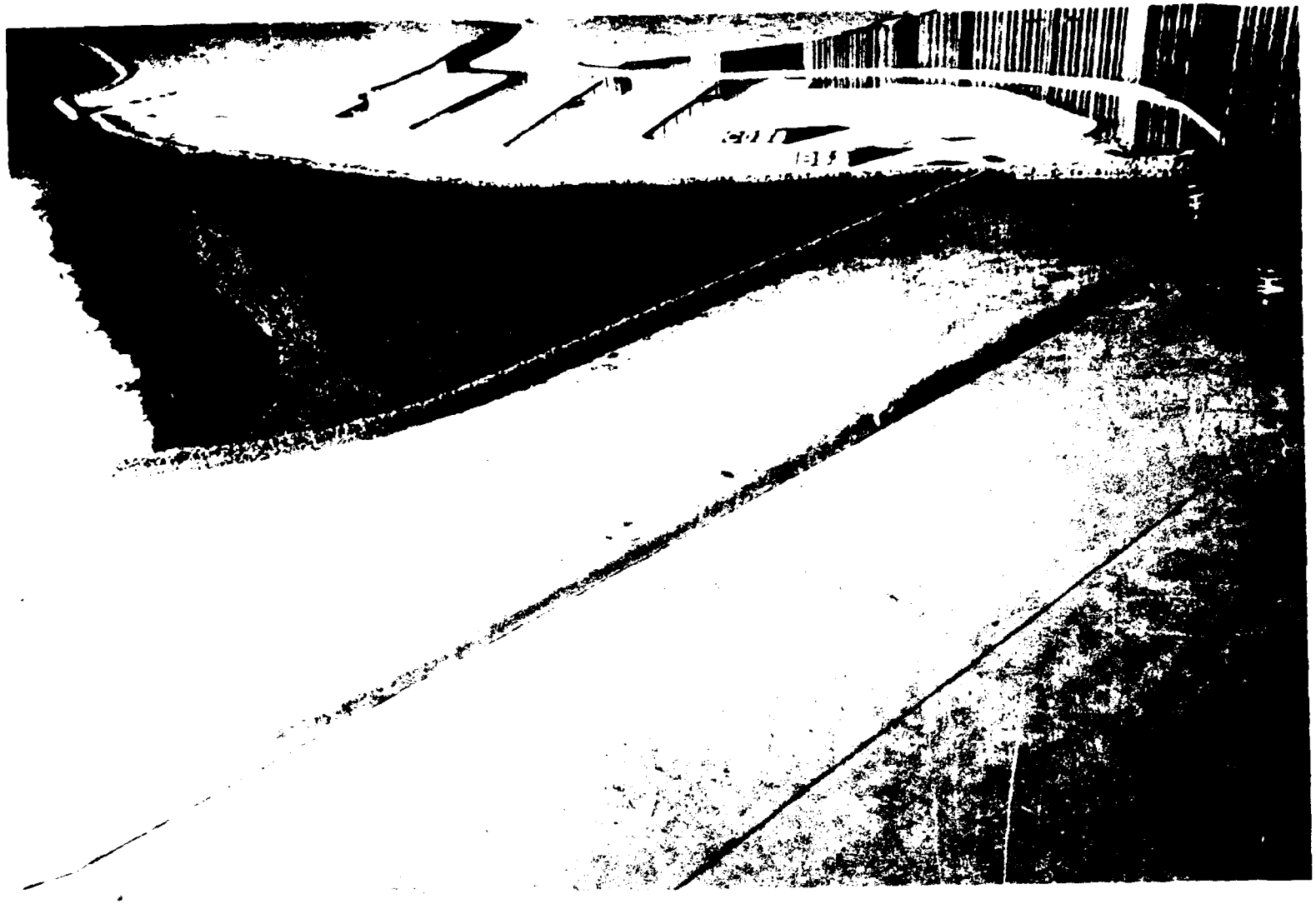

Photo 78. View of Plan 1 prior to model testing; +6.7 ft swl

Photo 79. Shoreline configuration for Plan 1 after initial testing with 11-sec, 10-ft test waves; +6.7 ft swl

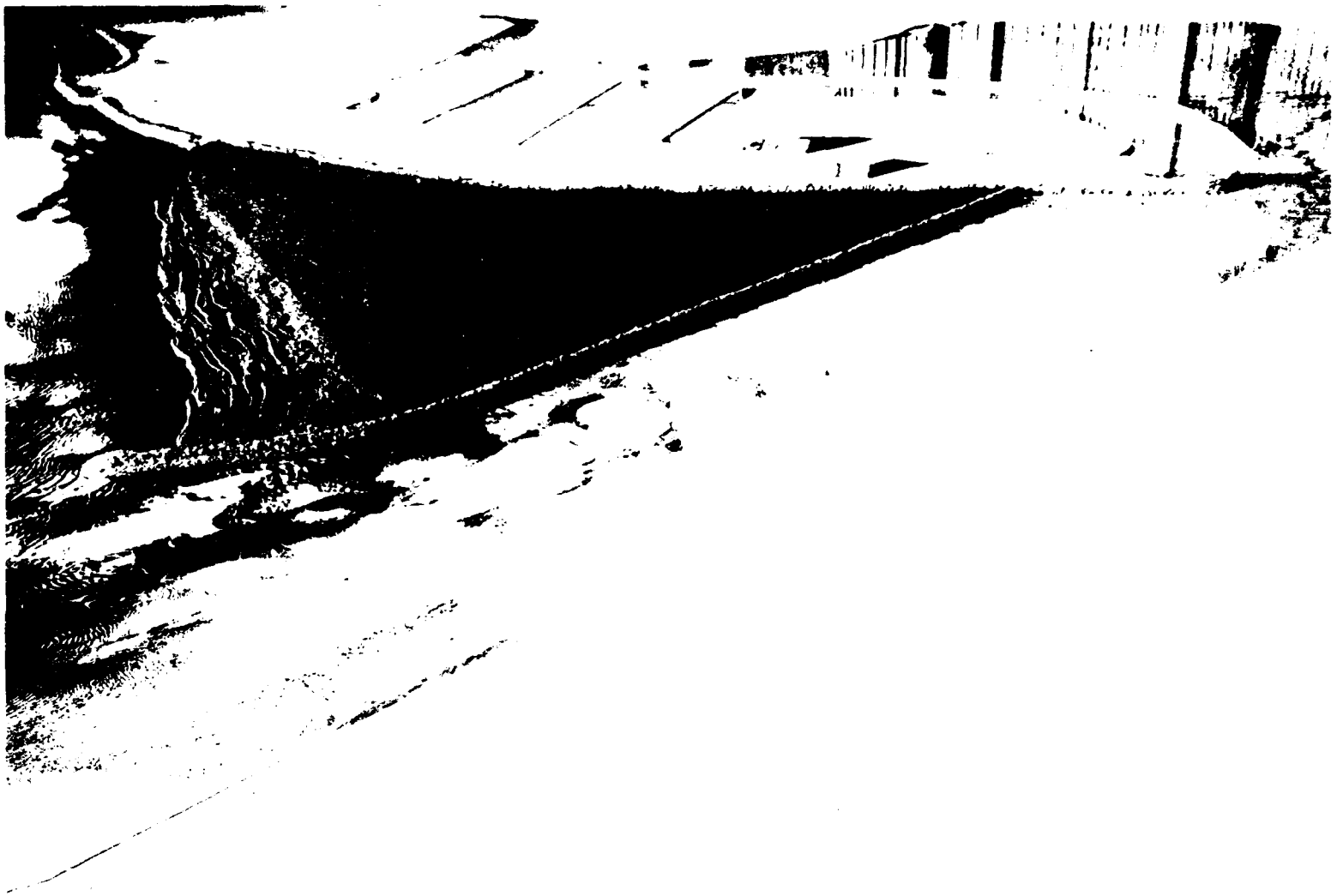

Photo 80. Shoreline configuration after additional testing of Plan 1 with 17-sec, 8-ft and 13-sec, 22-ft test waves; +6.7 ft swl

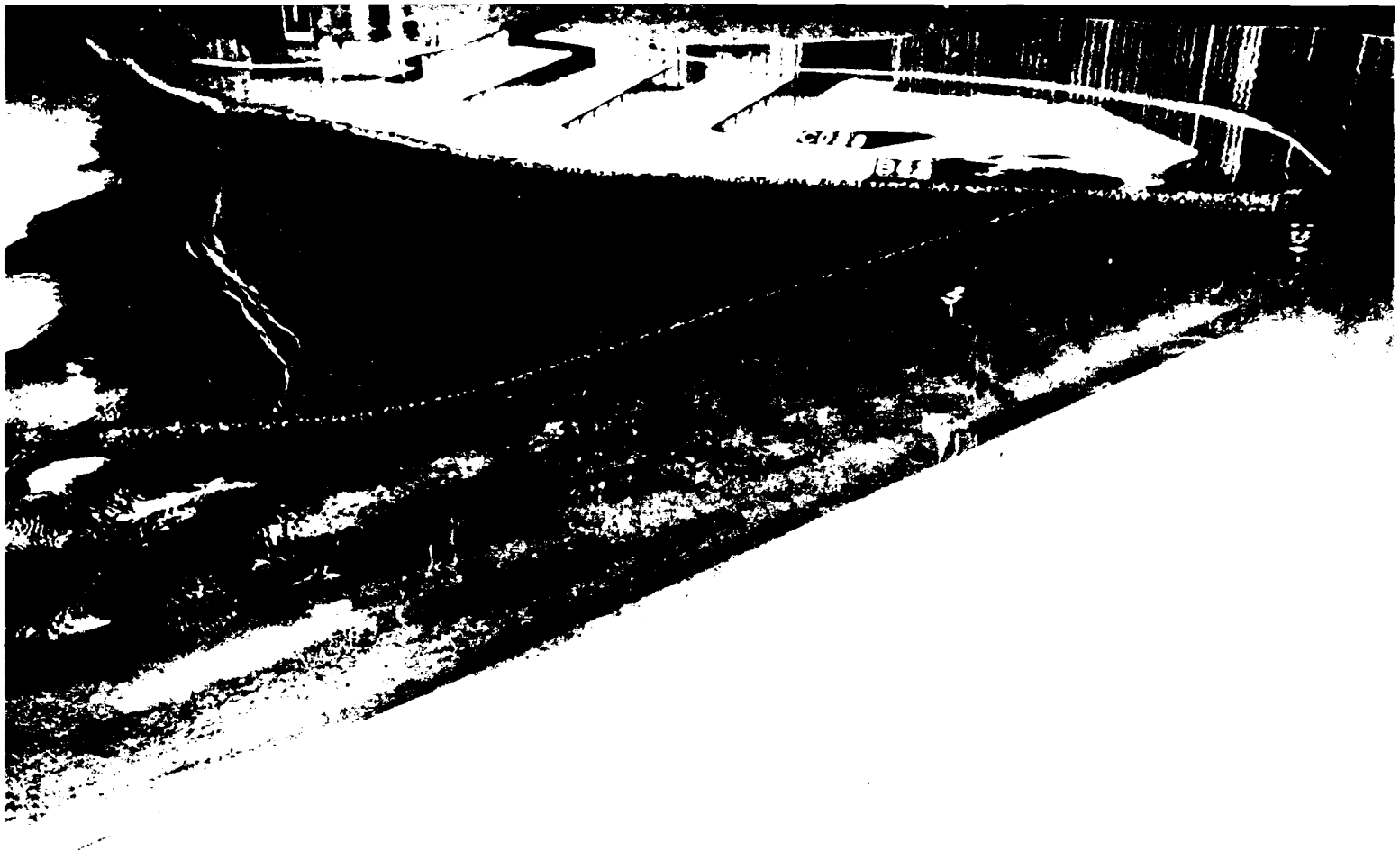

Photo 81. Shoreline configuration after testing of Plan 1 with test waves for the +6.7 and +9.5 ft swl's

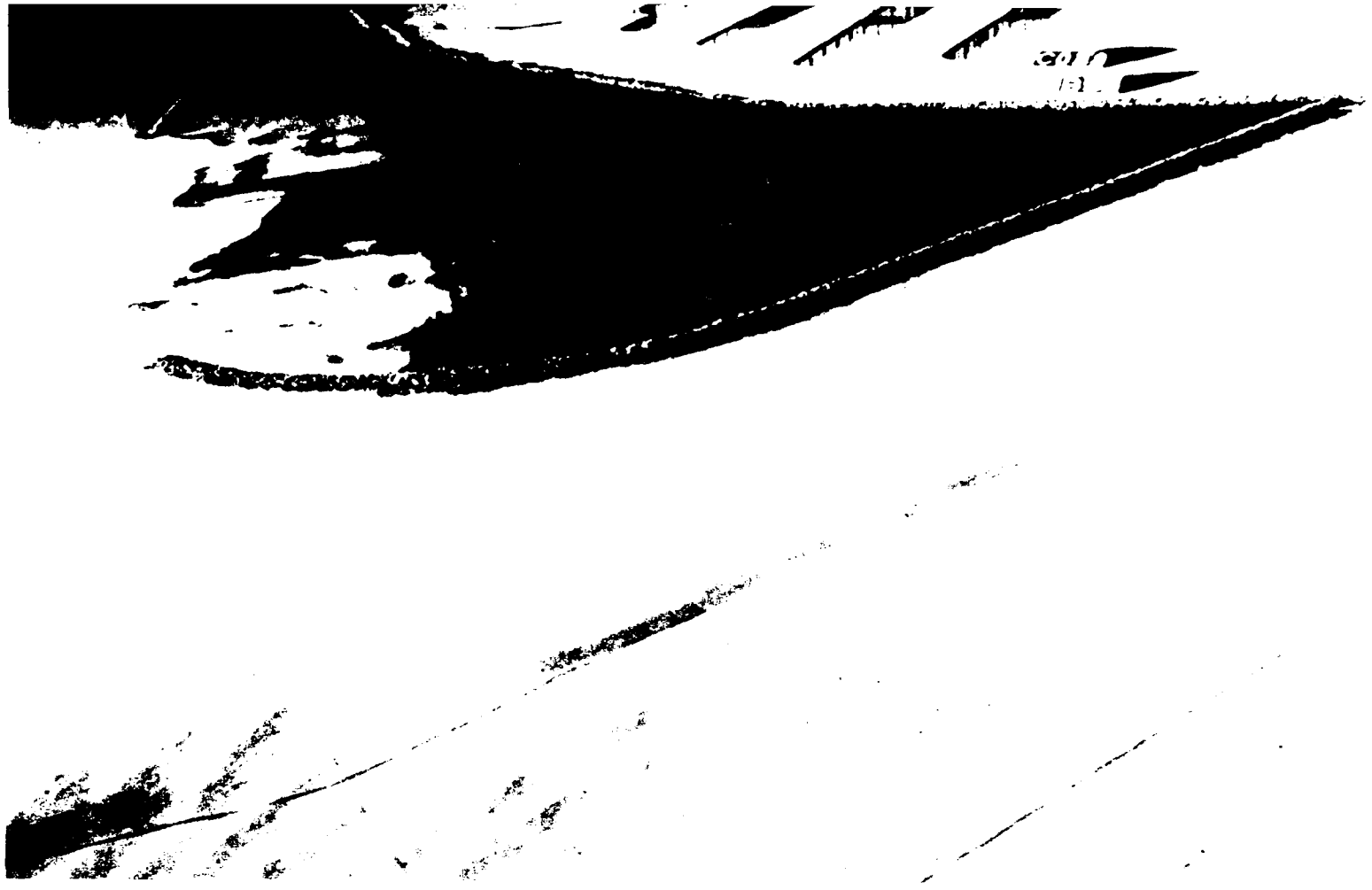

Photo 95. Shoreline configuration for Plan 3B after testing with 11-sec, 10-ft test waves; +6.7 ft swl

Photo 94. View of Plan 3B prior to model testing; +6.7 ft swl

Photo 93. Shoreline configuration for Plan 3A after testing with 11-sec, 10-ft test waves; +6.7 ft swl

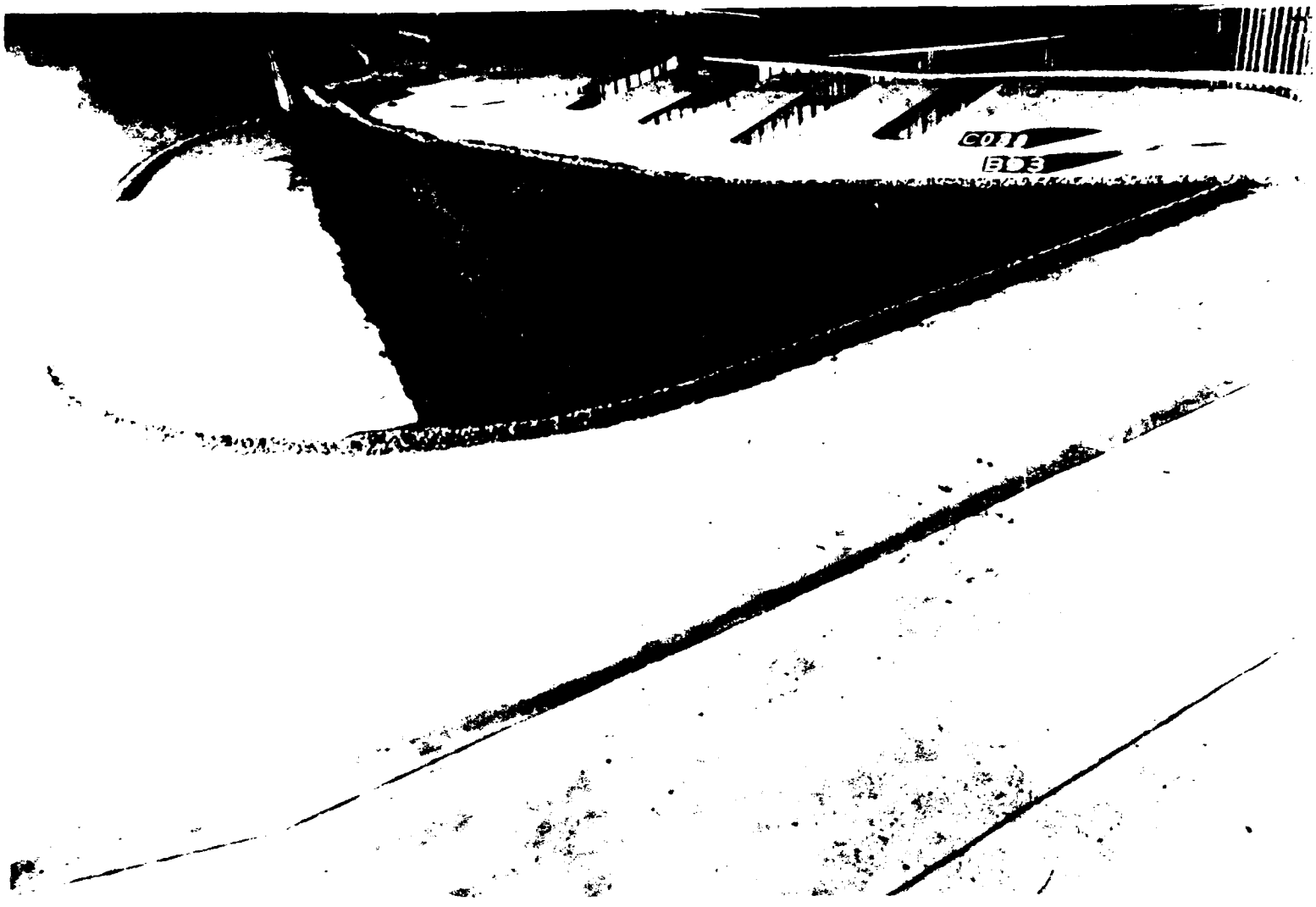

Photo 92. View of Plan 3A prior to model testing; +6.7 ft swl

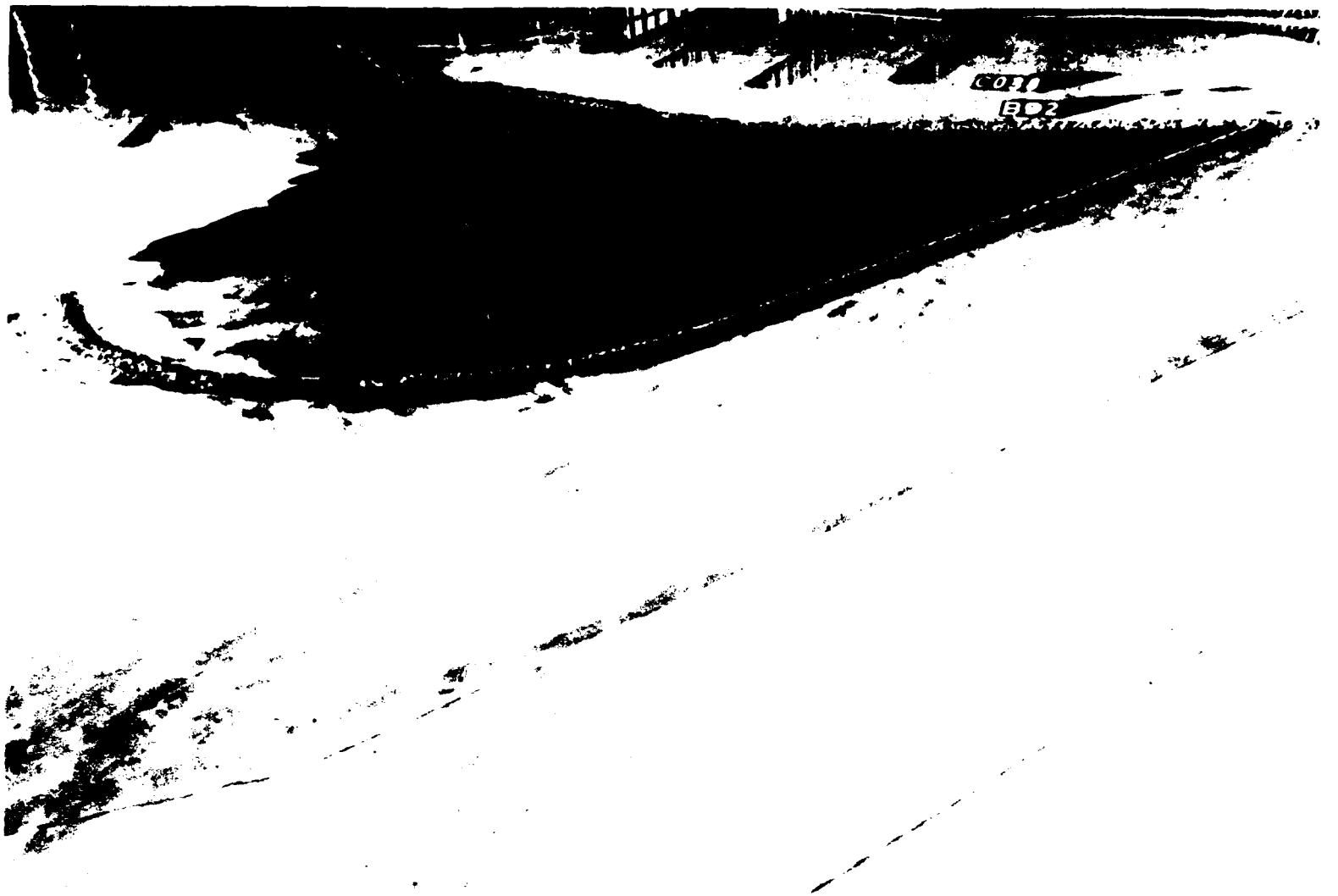

Photo 91. Shoreline configuration after additional testing of Plan 3 with 11-sec, 10-ft waves with the +9.5 ft swl

Photo 90. Shoreline configuration for Plan 3 after initial testing with 11-sec, 10-ft test waves; +6.7 ft swl

Photo 89. View of Plan 3 prior to model testing; +6.7 ft swl

Photo 88. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 2; 11-sec, 10-ft waves from northwest for maximum flood; +3.2 ft swl

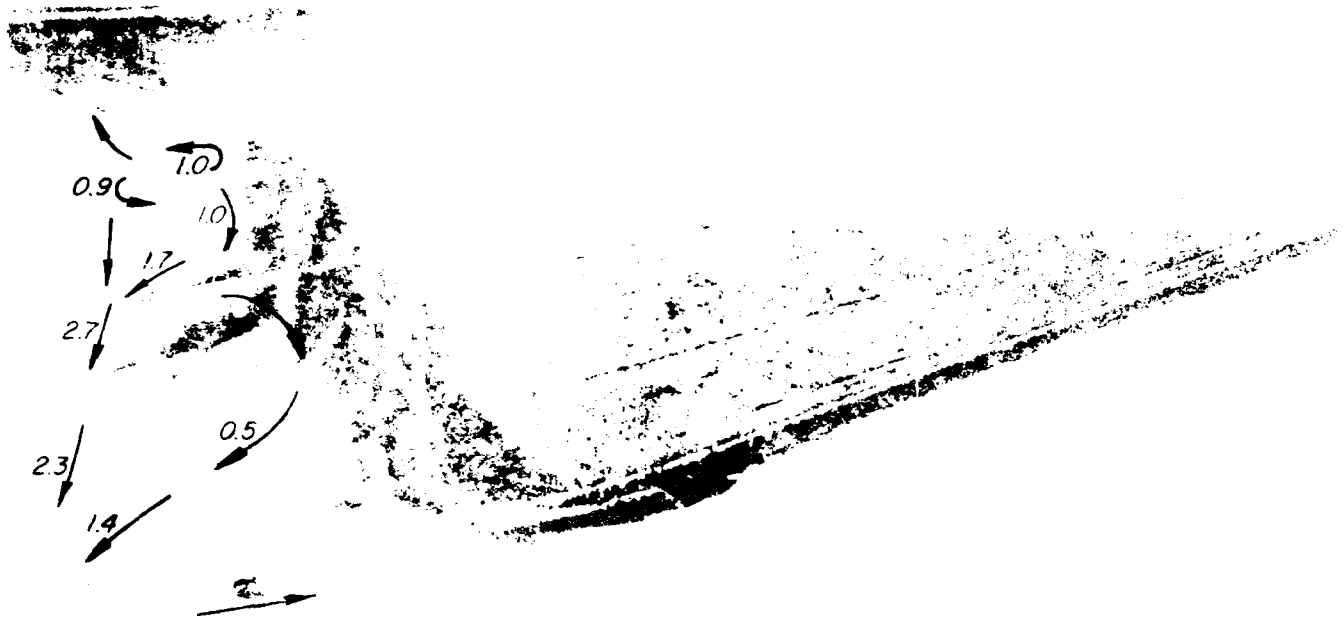

Photo 87. Typical wave patterns, current patterns, and current magnitudes (prototype test [illegible] for Plan 2; 11-sec, 30-ft waves; +9.5 ft swl

Photo 86. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 2; 11-sec, 10-ft waves; +6.7 ft swl

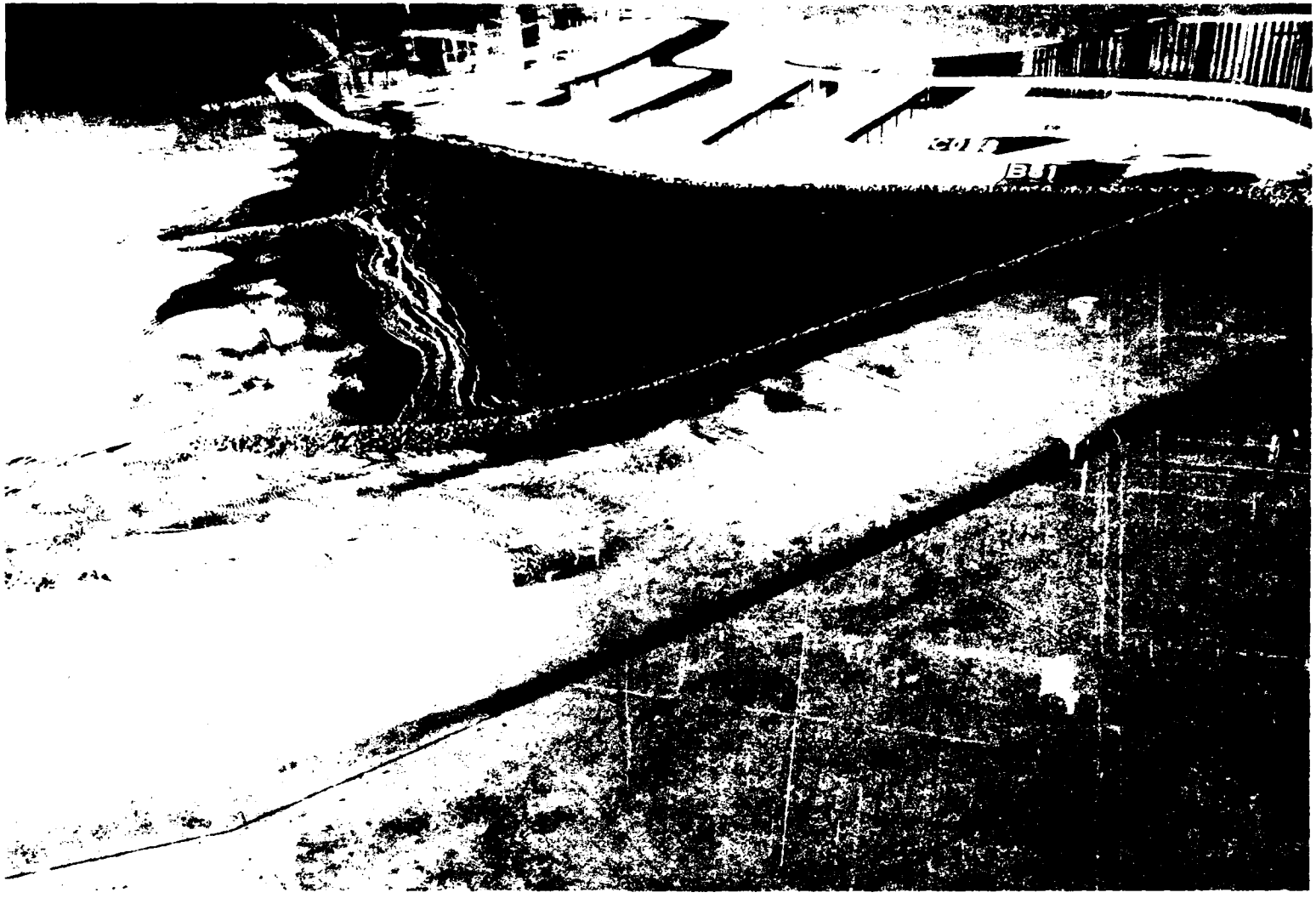

Figure 85. Shoreline configuration after testing of Plan 2 with test waves for the +6.7 and +9.5 ft swl's

Photo 84. Shoreline configuration for Plan 2 after testing with 11-sec, 10-ft test waves; +6.7 ft swl

Photo 83. View of Plan 2 prior to model testing; +6.7 ft swl

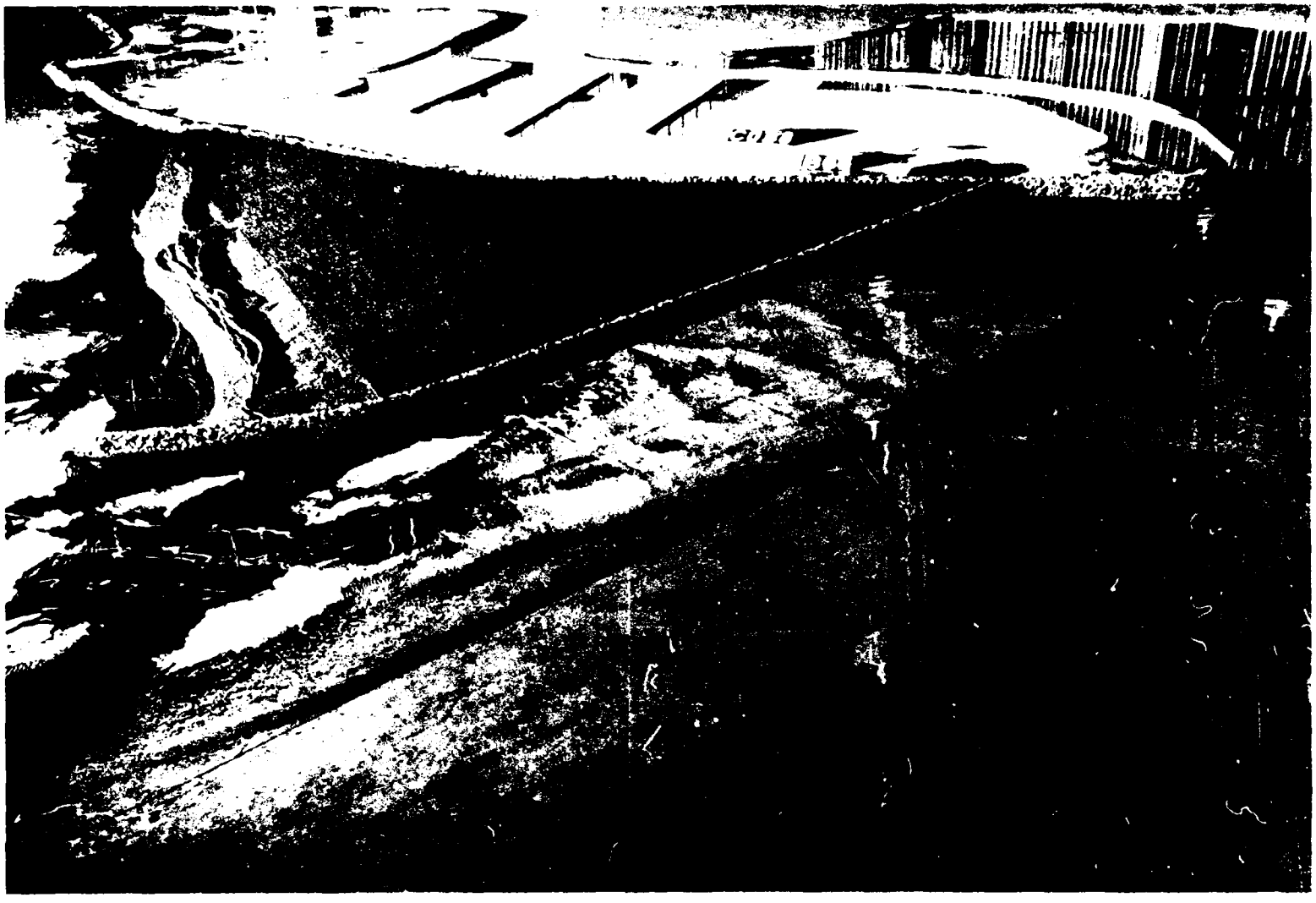

Photo 82. Shoreline configuration after testing of Plan 1 with test waves for the +6.7 and +3.2 ft swl's

Photo 96. View of Plan 3C prior to model testing; +9.5 ft swl

Photo 97. Shoreline configuration for Plan 3C after initial testing with 11-sec, 10-ft test waves; +9.5 ft swl

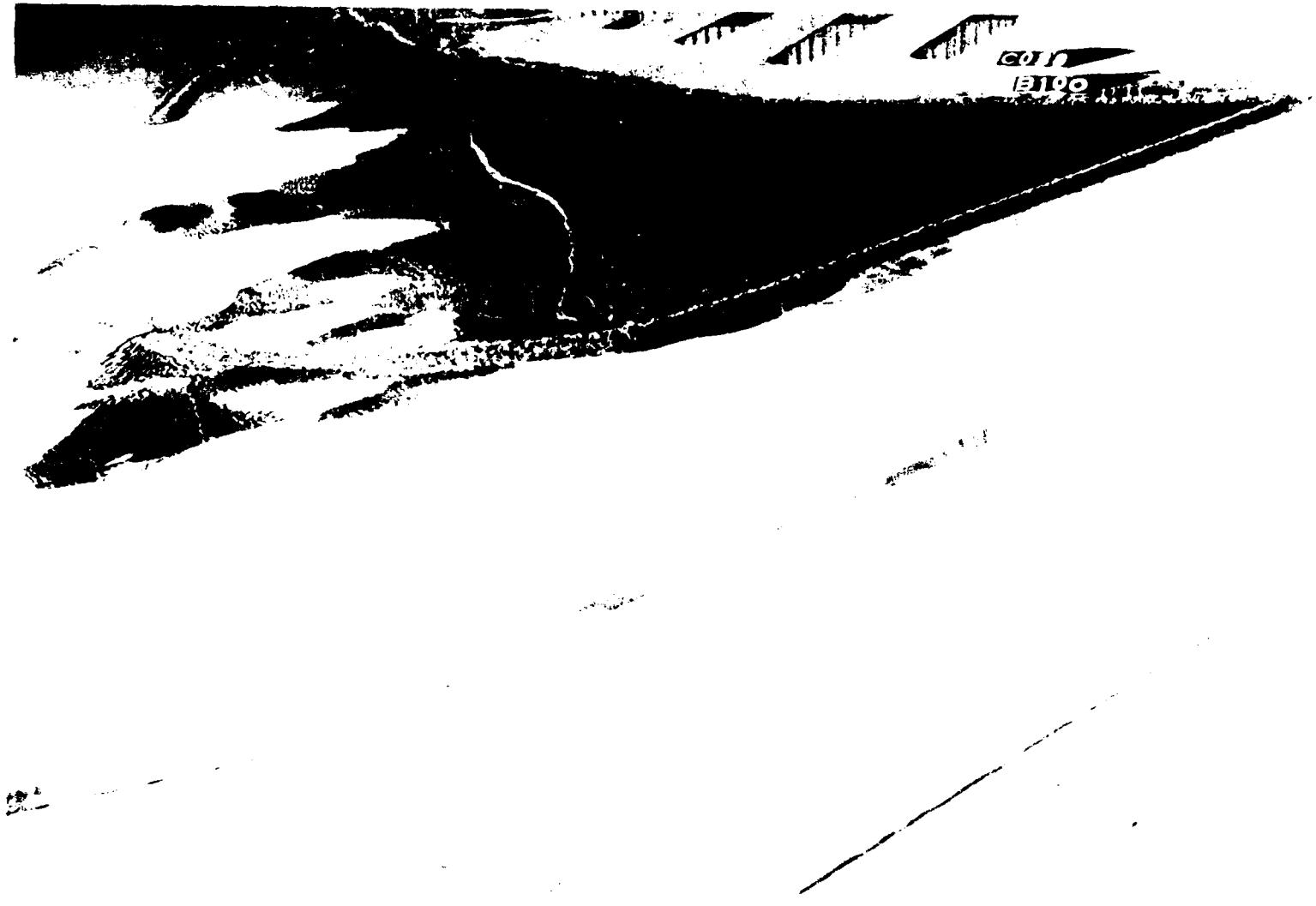

Photo 98. Shoreline configuration for Plan 3C after testing with 11-sec, 10-ft and 13-sec, 22-ft test waves; +9.5 ft swl

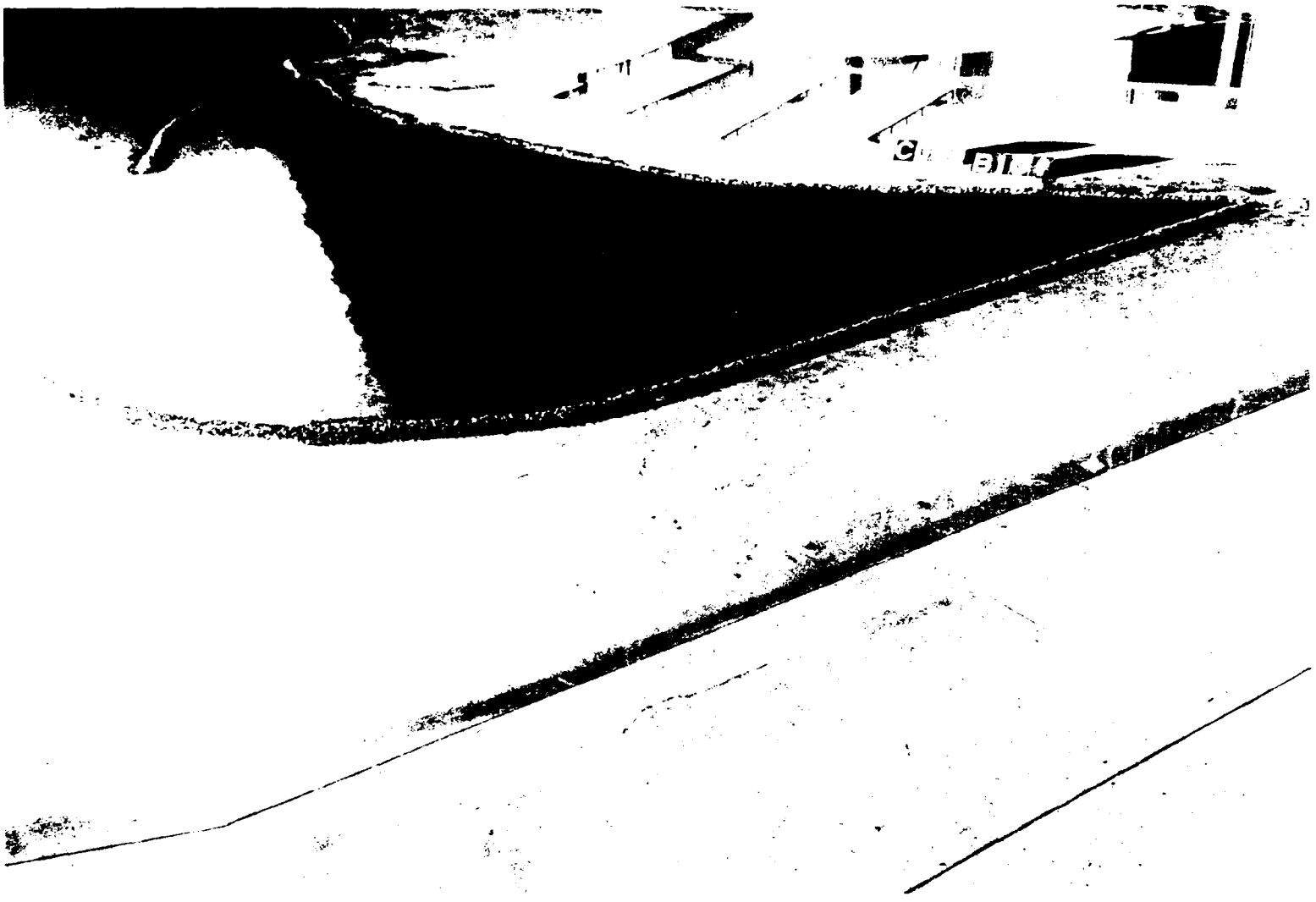

Photo 99. View of Plan 3D prior to model testing; +9.5 ft swl

Photo 100. Shoreline configuration for Plan 3D after initial testing with 11-sec, 10-ft test waves; +9.5 ft swl

Photo 101. Shoreline configuration for Plan 3D after testing with all test waves for the +9.5 ft swl

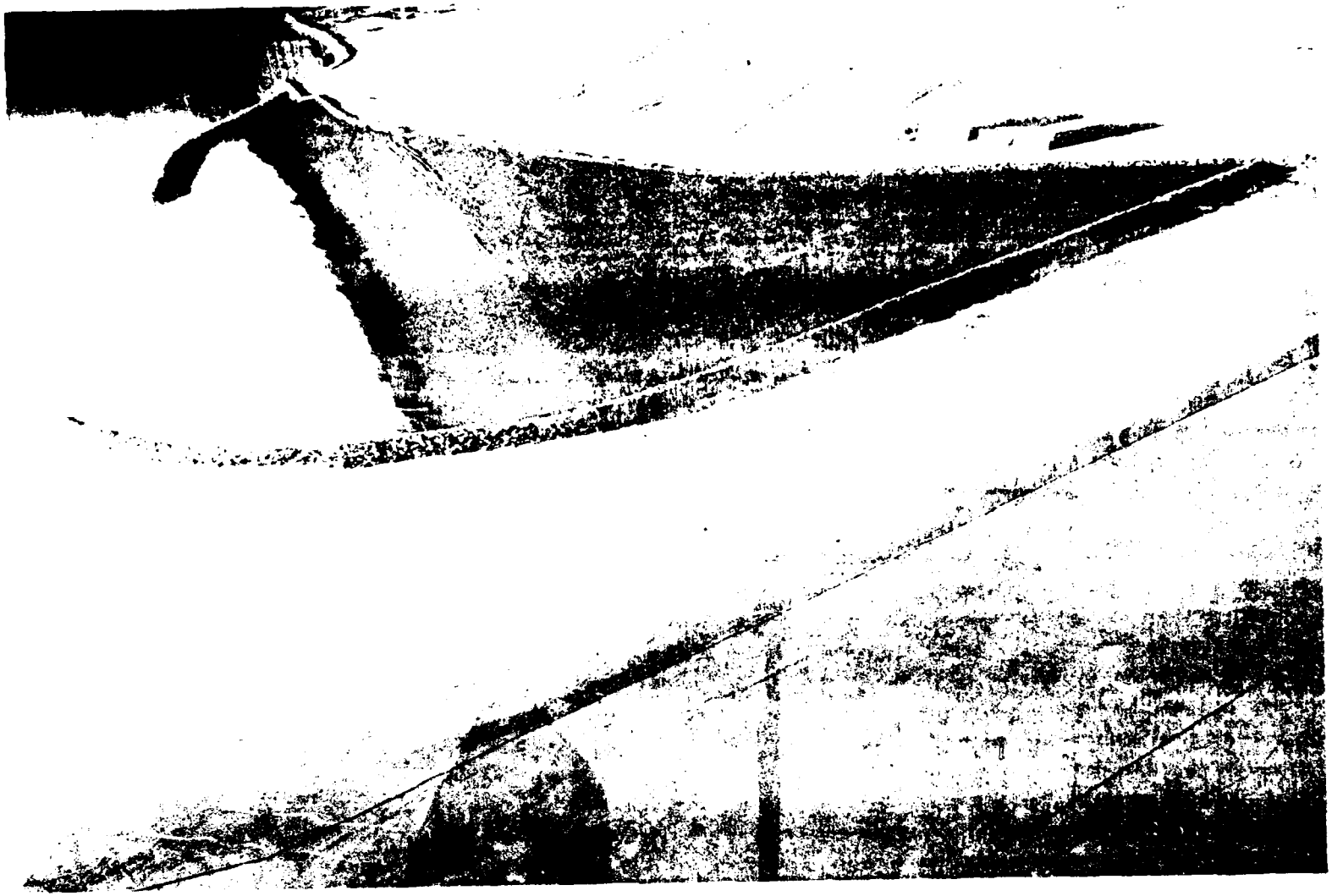

Photo 102. View of Plan 3D prior to model testing; 0.0-ft swl

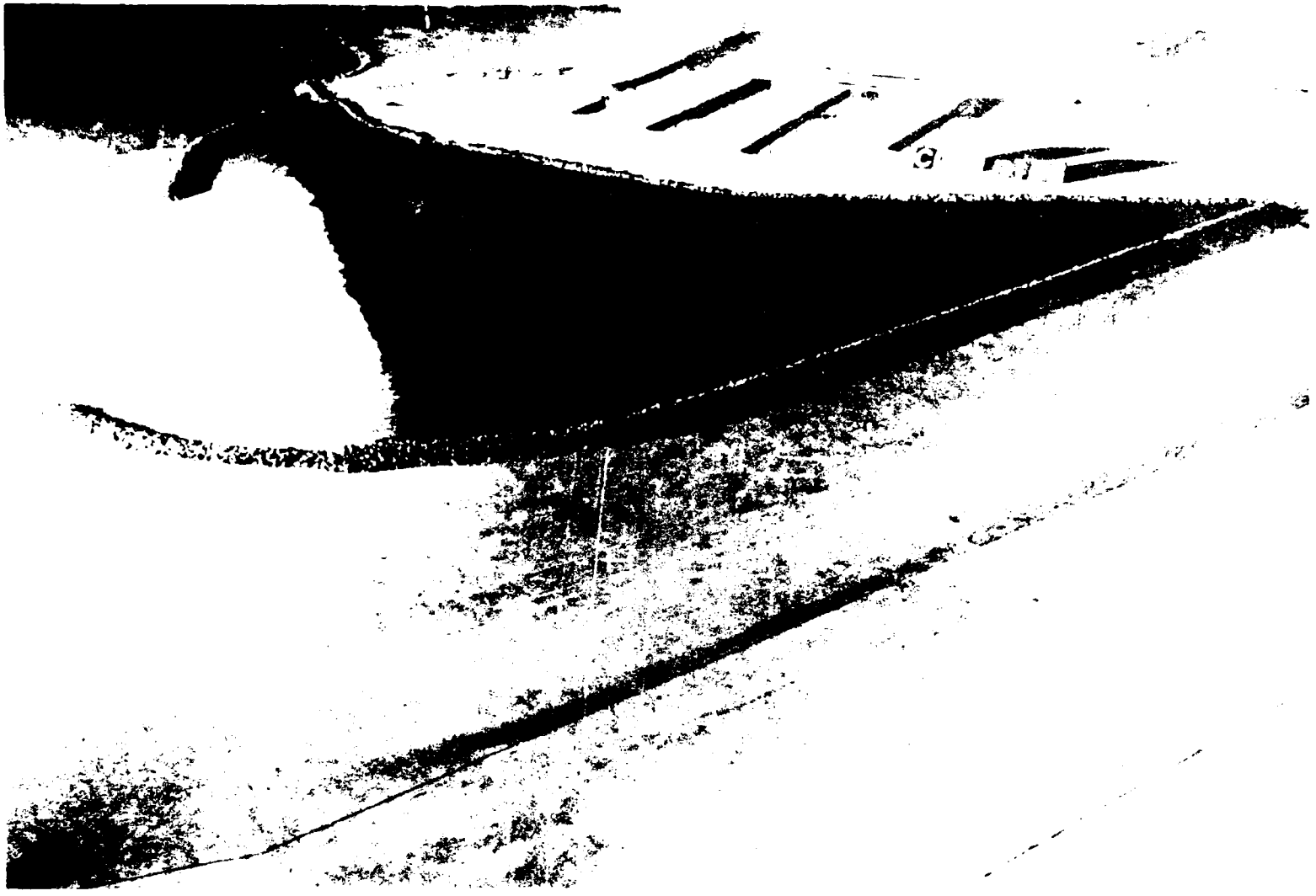

Photo 103. Shoreline configuration for Plan 3D after testing with all test waves for the 0.0-ft swl

Photo 104. View of Plan 3D prior to model testing; +3.2 ft swl

Photo 105. Shoreline configuration for Plan 3D after testing with all test waves for the +3.2 ft swl with maximum flood tidal flow

Photo 106. View of Plan 3D prior to model testing; +3.7 ft swl

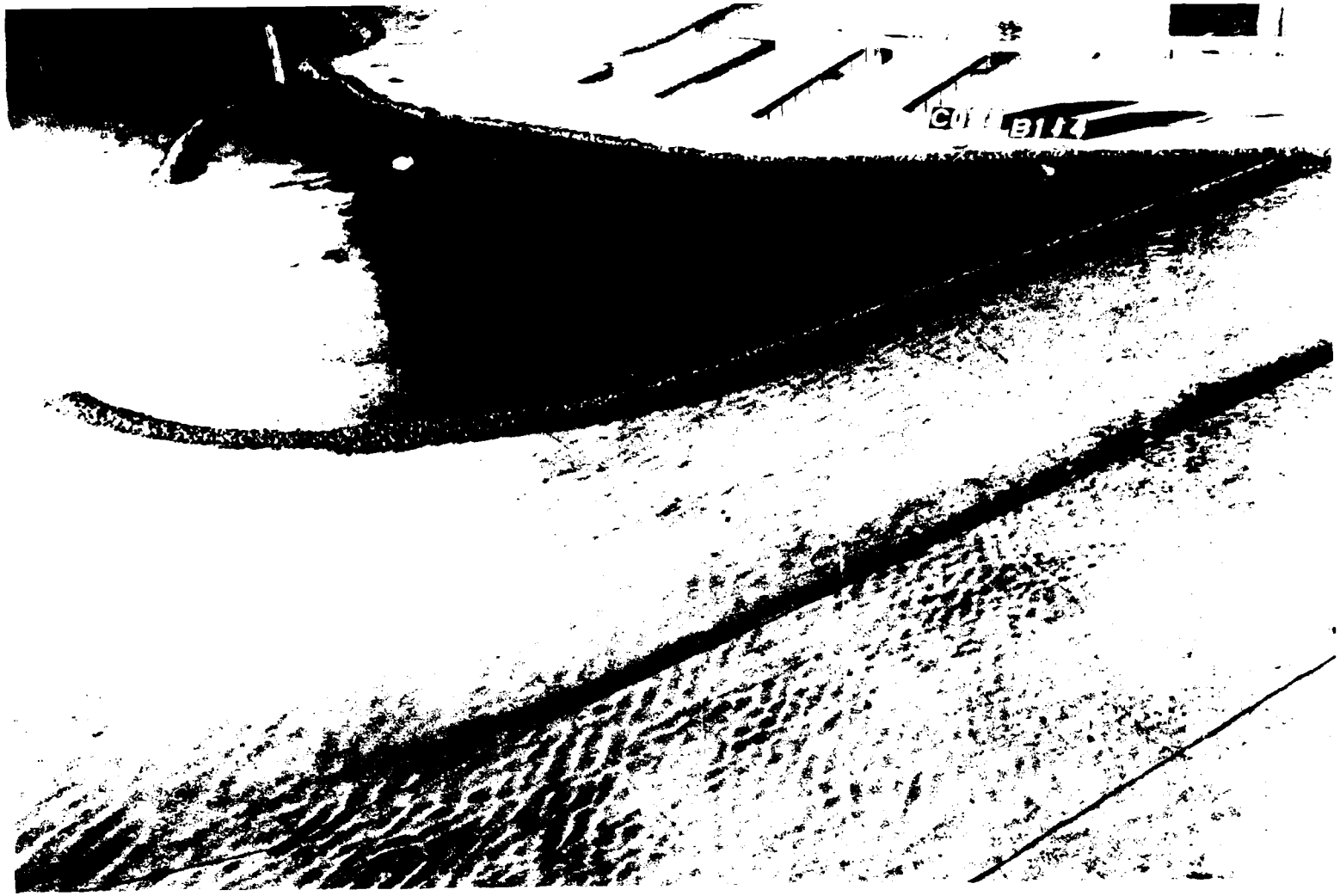

Photo 107. Shoreline configuration for Plan 3D after testing with all test waves for the +3.7 ft swl with maximum ebb tidal flow

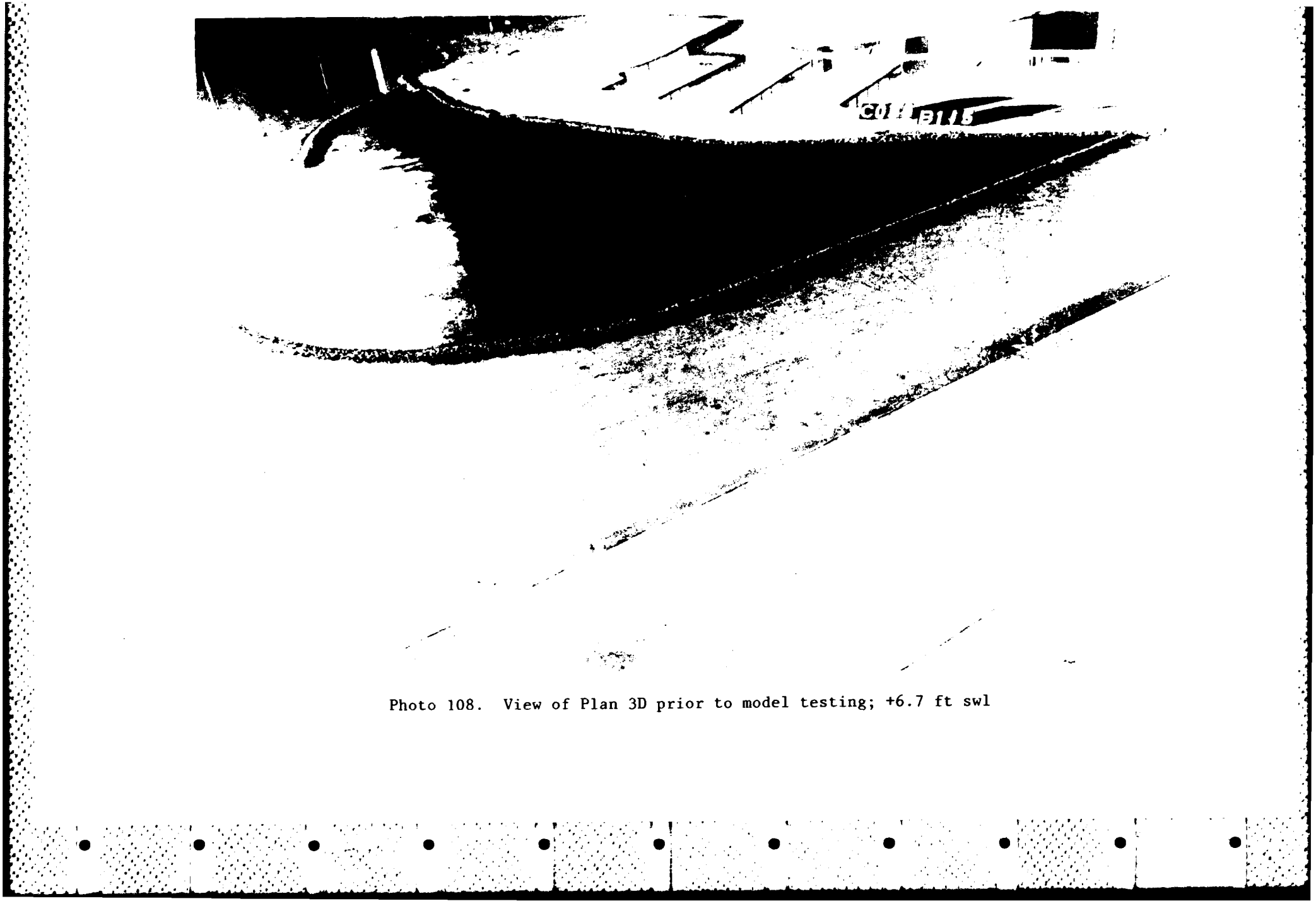

Photo 108. View of Plan 3D prior to model testing; +6.7 ft swl

Photo 109. Shoreline configuration for Plan 3D after testing with all test waves for the +6.7 ft swl

AD-A152 327 BUHNE POINT HUMBOLDT BAY CALIFORNIA DESIGN FOR THE PREVENTION OF SHORELIN..(U) COASTAL ENGINEERING RESEARCH CENTER VICKSBURG MS R R BOTTIN ET AL. NOV 84 3/4

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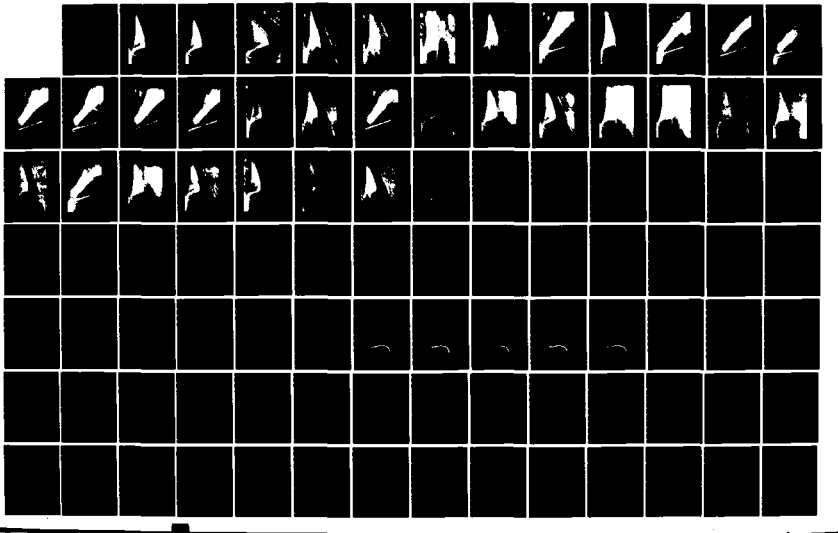

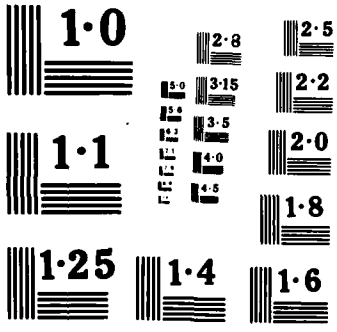
1·0
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1·6
1·8
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2·2
2·5
2·8
3·15
3·5
4·0
4·5

Photo 110. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 3D; 11-sec, 10-ft waves; 0.0-ft swl

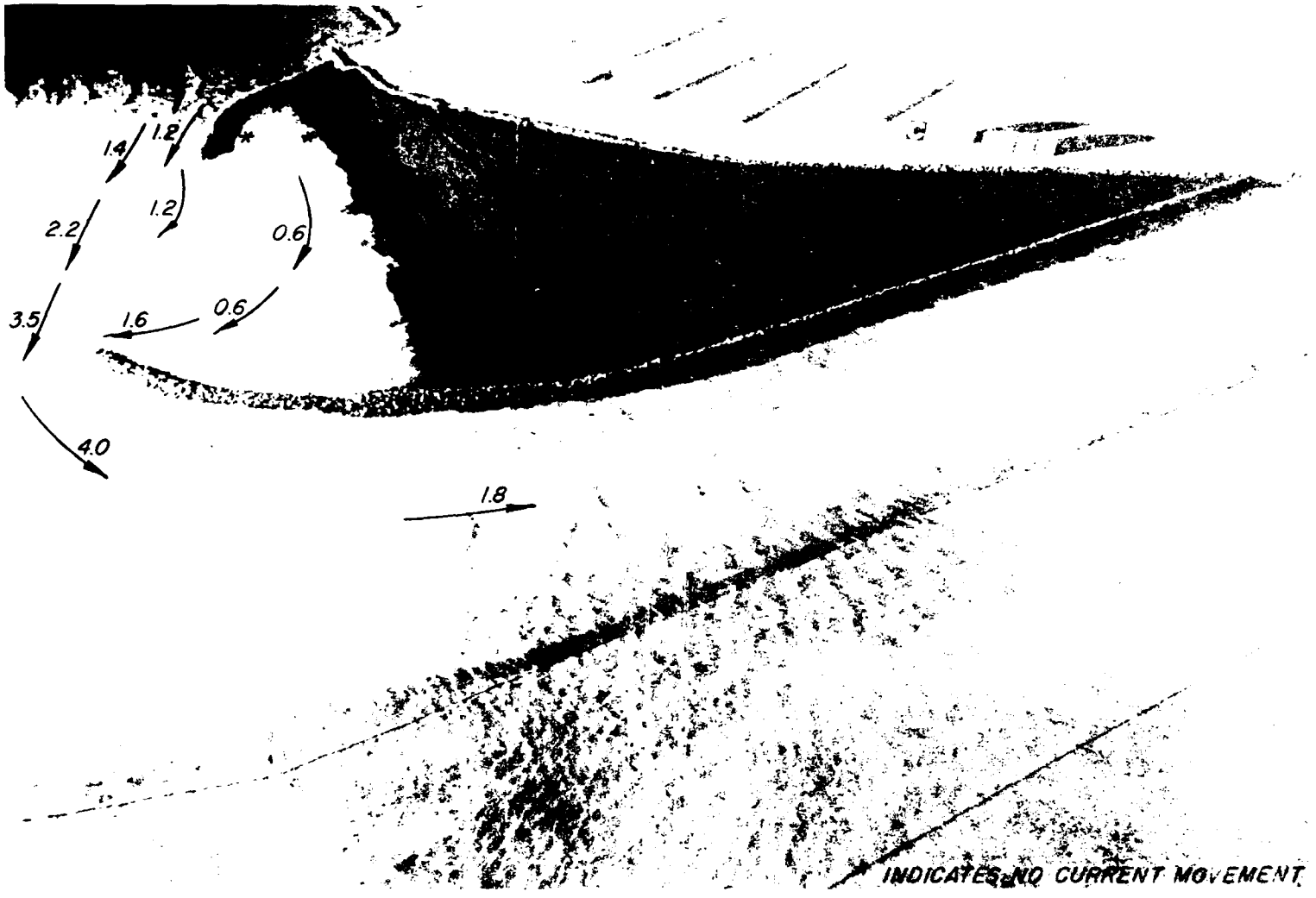


Photo 111. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 3D; 11-sec, 10-ft waves for maximum flood; +3.2 ft swl

Photo 112. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 3D; 11-sec, 10-ft waves for maximum ebb; +3.7 ft swl

Photo 113. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 3D; 11-sec, 10-ft waves; +6.7 ft swl

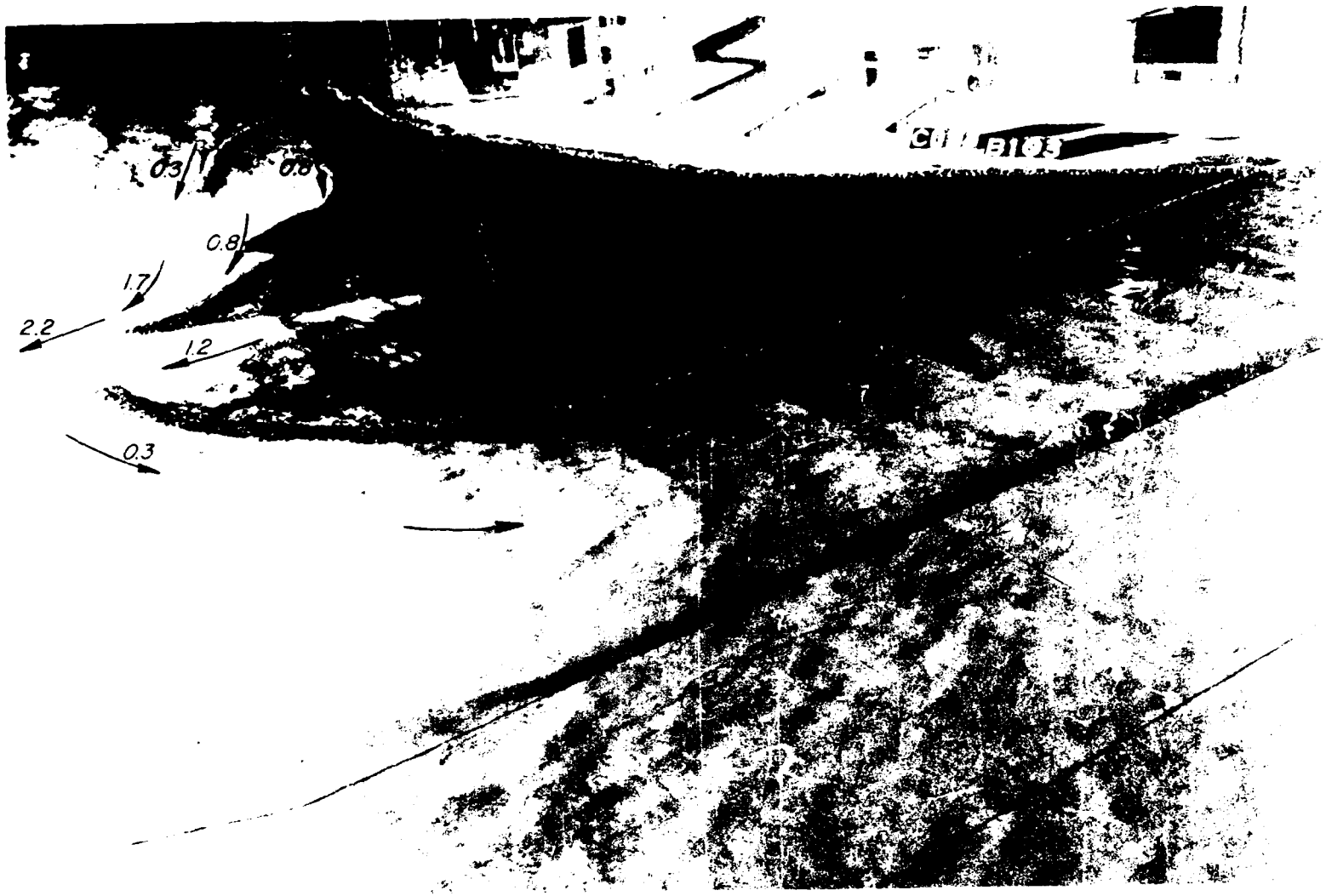


Photo 114. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 3D; 11-sec, 10-ft waves; +9.5 ft swl

Photo 115. View of Plan 4 prior to model testing; +9.5 ft swl

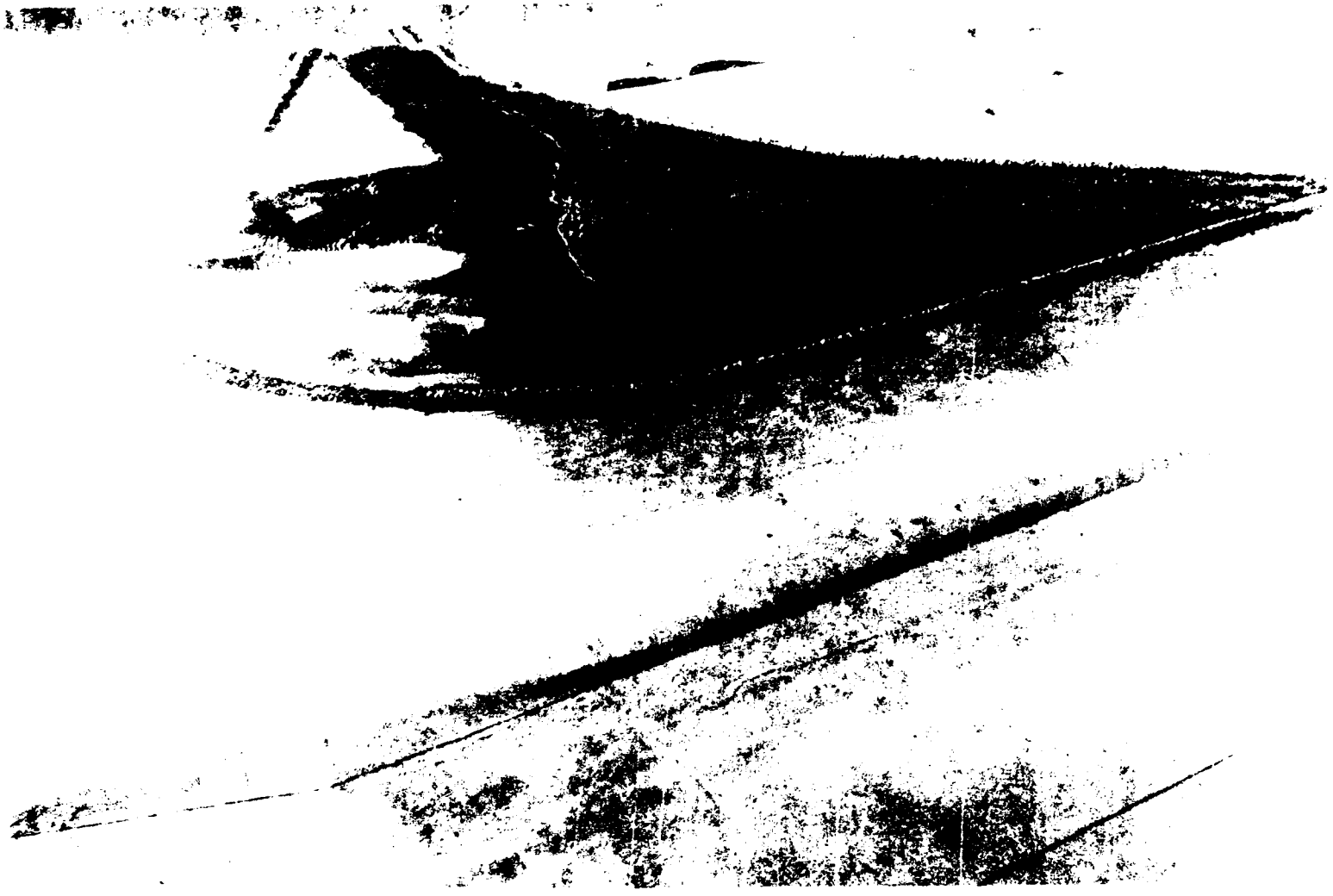


Photo 116. Shoreline configuration of Plan 4 after testing with 11-sec, 10-ft waves, +9.5 ft swl

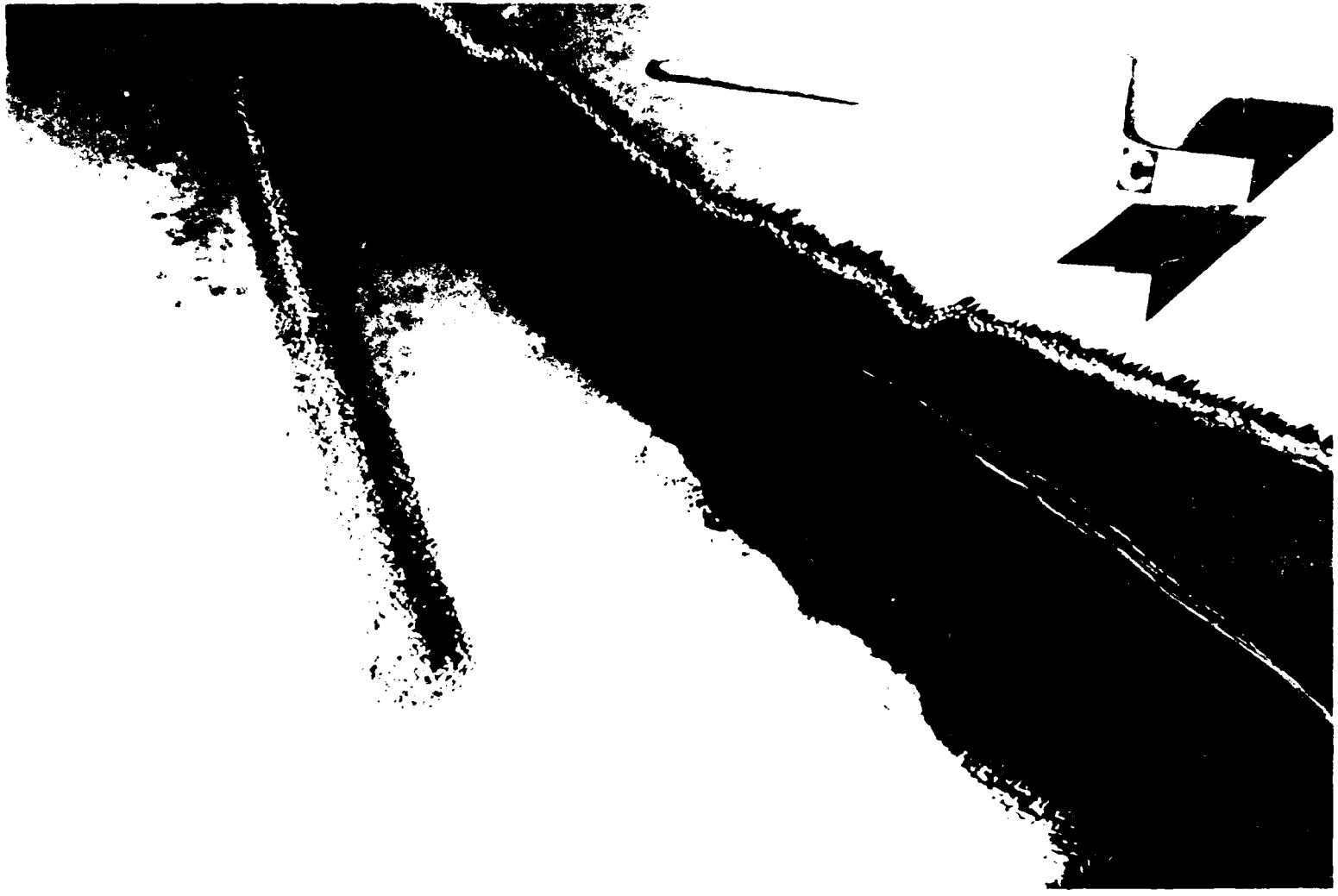


Photo 117. Shoreline configuration in lee of breakwater for Plan 4 after testing with 11-sec, 10-ft waves, +9.5 ft swl

Photo 118. View of Plan 4A prior to model testing; +9.5 ft swl

Photo 119. Shoreline configuration in lee of breakwater for Plan 4A after testing with 11-sec, 10-ft waves, +9.5 ft swl

Photo 120. View of offshore breakwater of Plan 4B prior to model testing; +9.5 ft swl

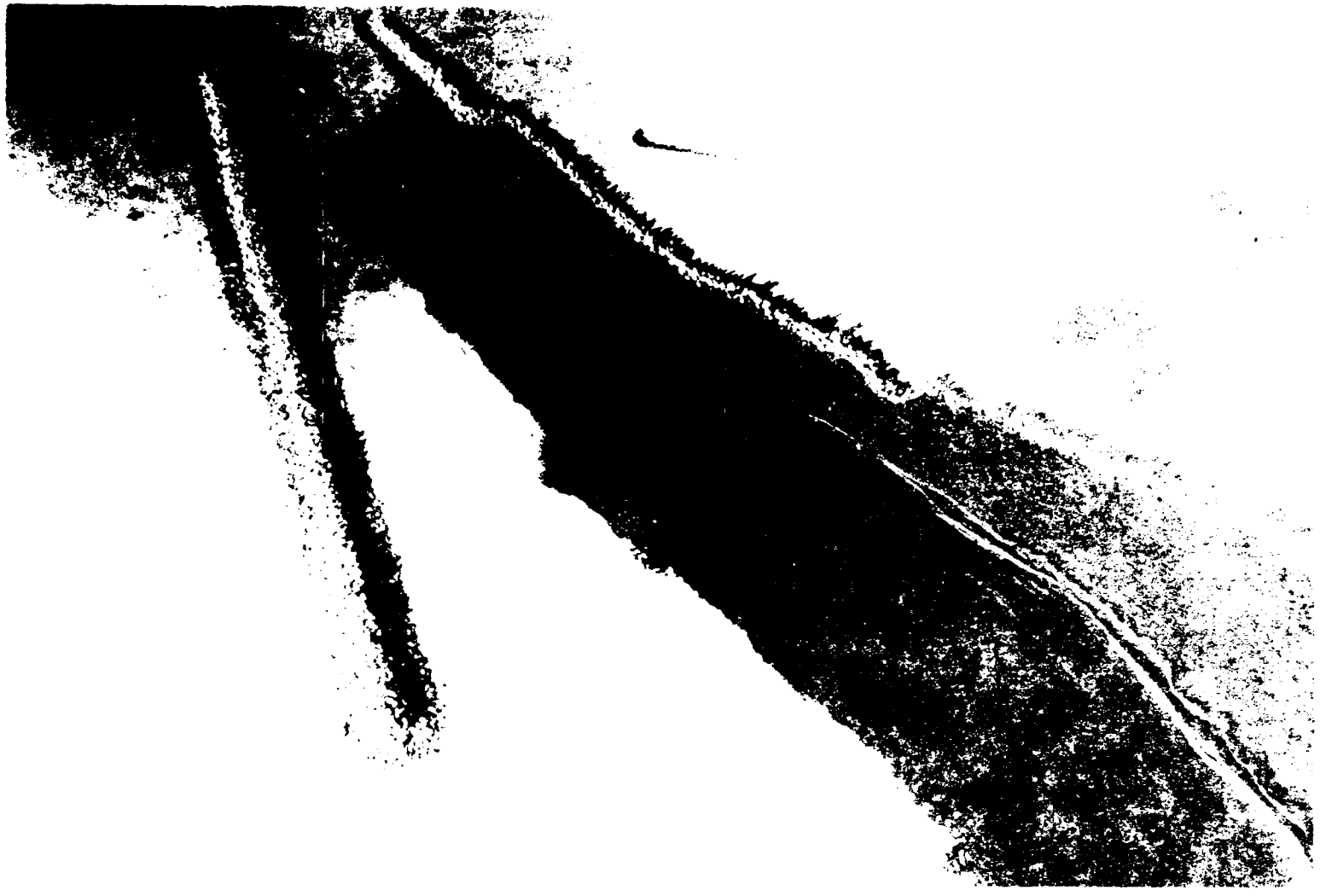


Photo 121. Shoreline configuration in lee of breakwater for Plan 48 after testing with 11-sec, 10-ft waves, 49.5 ft swl

Photo 135. View of Plan 4B prior to model testing; +6.7 ft swl

Photo 134. Shoreline configuration for Plan 4B after testing with all test waves to the +3.7 ft MSL with maximum ebb tidal flow

Photo 133. View of Plan 4B prior to model testing; +3.7 ft swl

Photo 132. Shoreline configuration for Plan 4B after testing with all test waves for the +3.2 ft swl with maximum flood tidal flow

Photo 131. View of Plan 4B prior to model testing; +3.2 ft swl

Photo 130. Shoreline figuration for Plan 4B after testing with all test waves for the 0.0-ft swl

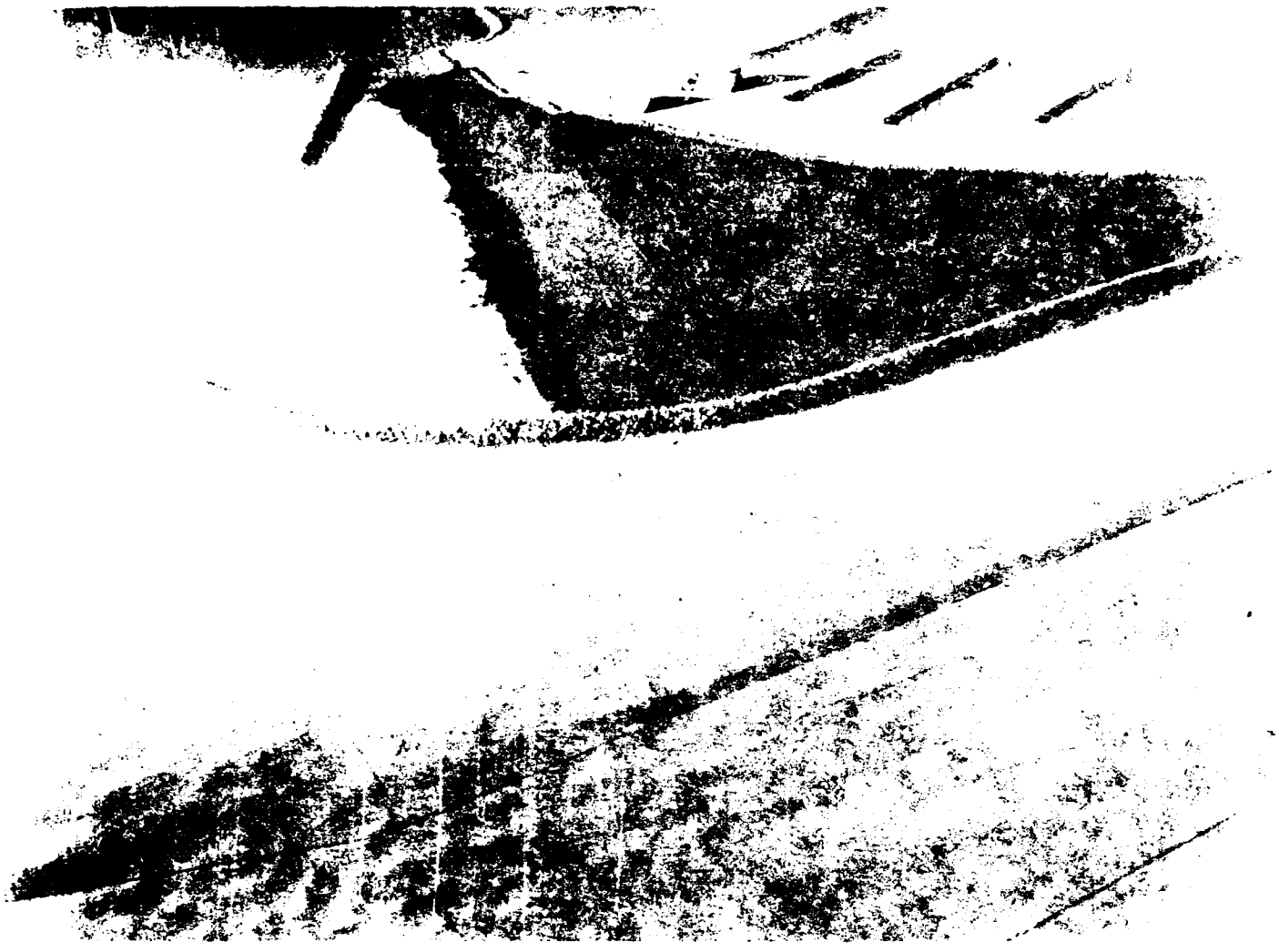


Photo 129. View of Plan 4B prior to model testing; 0.0-ft swl

Photo 128. Shoreline configuration in lee of breakwater for Plan 4B after testing with all test waves for the +9.5 ft swl

Photo 127. Shoreline configuration for Plan 4B after testing with all test waves for the 12.5 ft swl

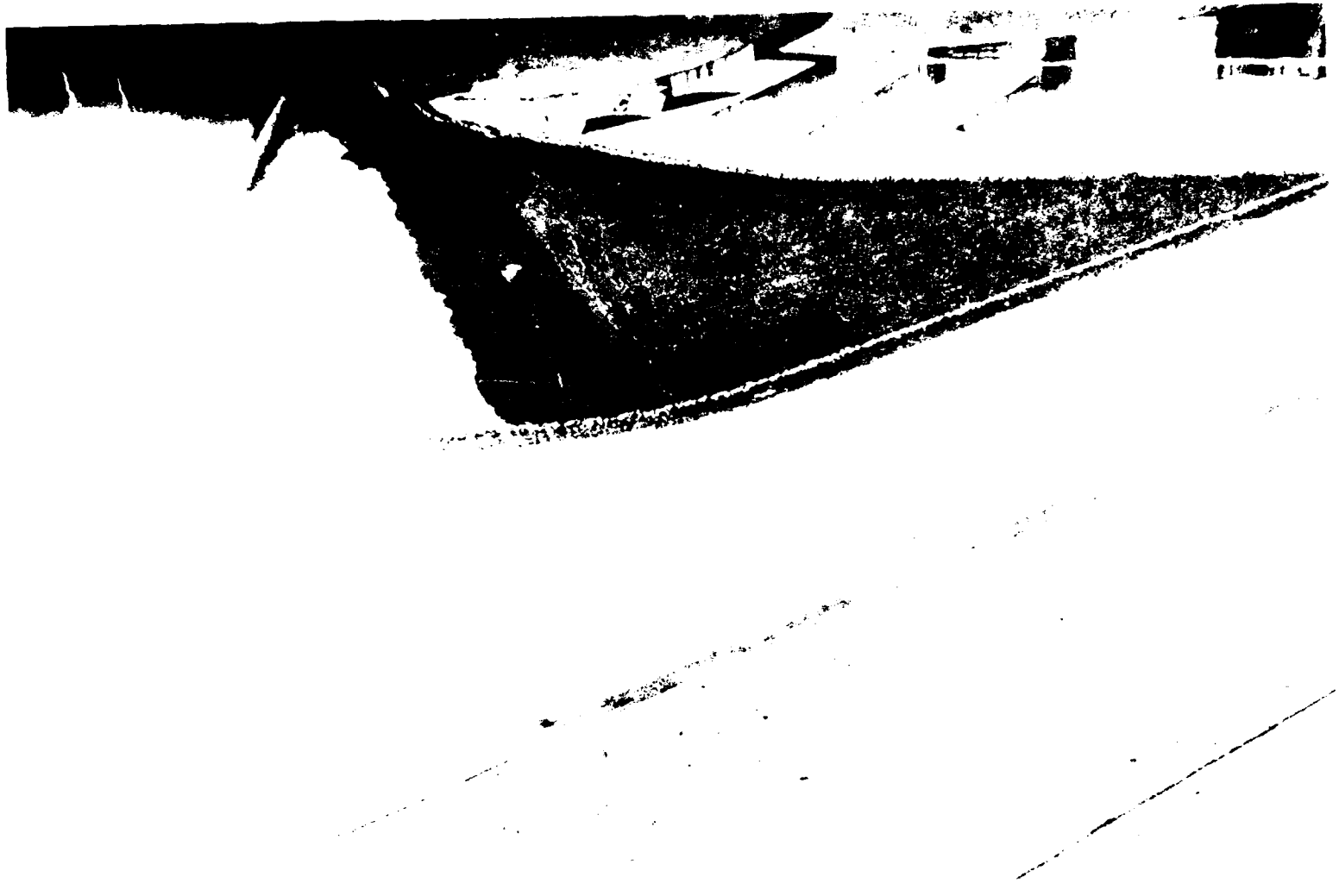


Photo 126. View of Plan 4B prior to model testing; 49.5 ft swl

Photo 125. View of offshore breakwater of Plan 4F prior to model testing; +9.5 ft swl

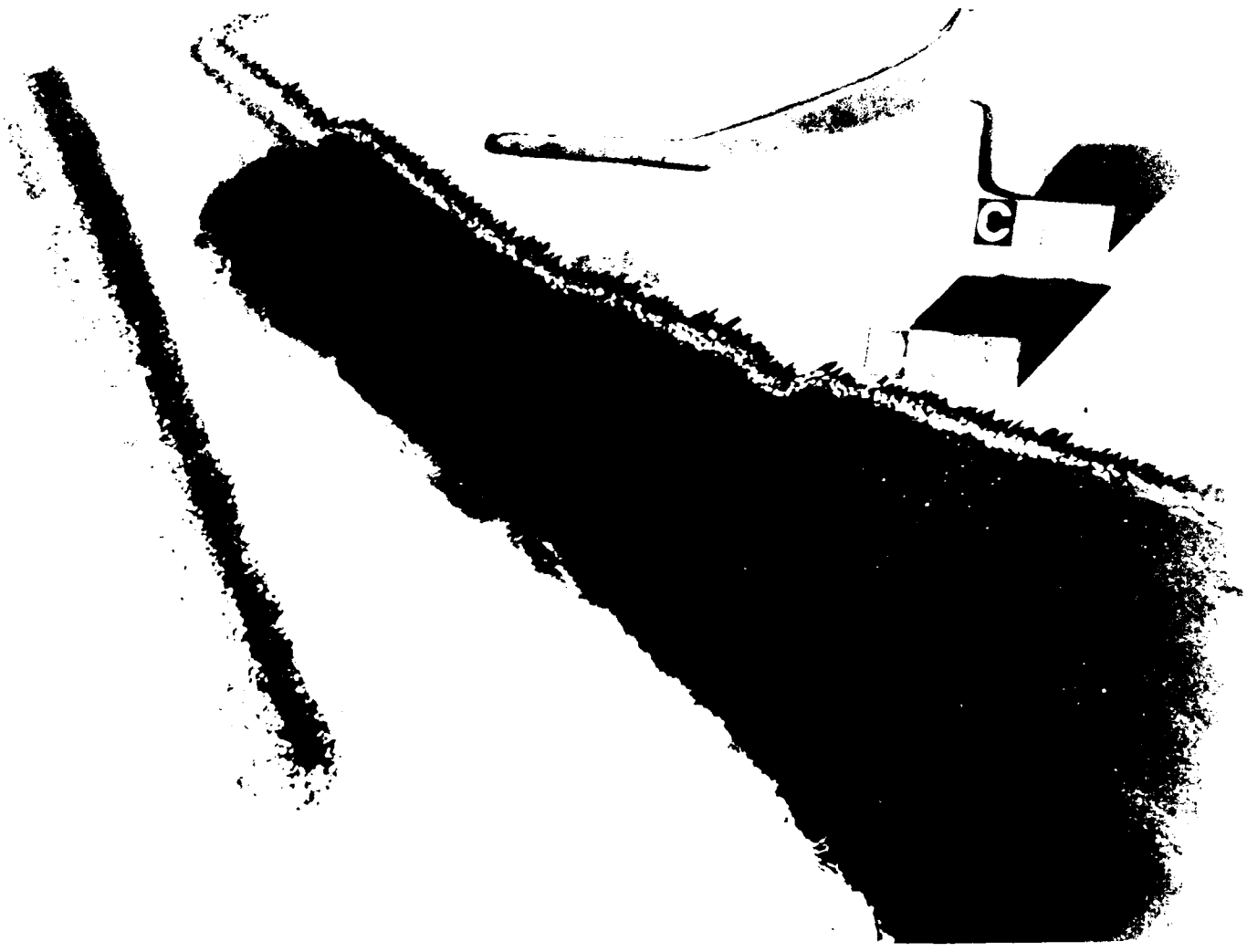


Photo 124. View of offshore breakwater of Plan 4E prior to model testing; +9.5 ft swl

Photo 123. Shoreline configuration in lee of breakwater for Plan 4C after testing with 13-sec, 22-ft and 15-sec, 9-ft test waves; +9.5 ft swl

Photo 122. View of offshore breakwater of Plan 4C prior to model testing; +9.5 ft swl

Photo 136. Shoreline configuration for Plan 4B after testing with all test waves for the +6.7 ft swl

Photo 137. Shoreline configuration in lee of breakwater for Plan 4R after testing with all test waves for the +6.7 ft swl

Photo 138. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 4B; 11-sec, 10-ft waves; 0.0-ft swl

Photo 139. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 4B; 11-sec, 10-ft waves for maximum flood; +3.2 ft swl

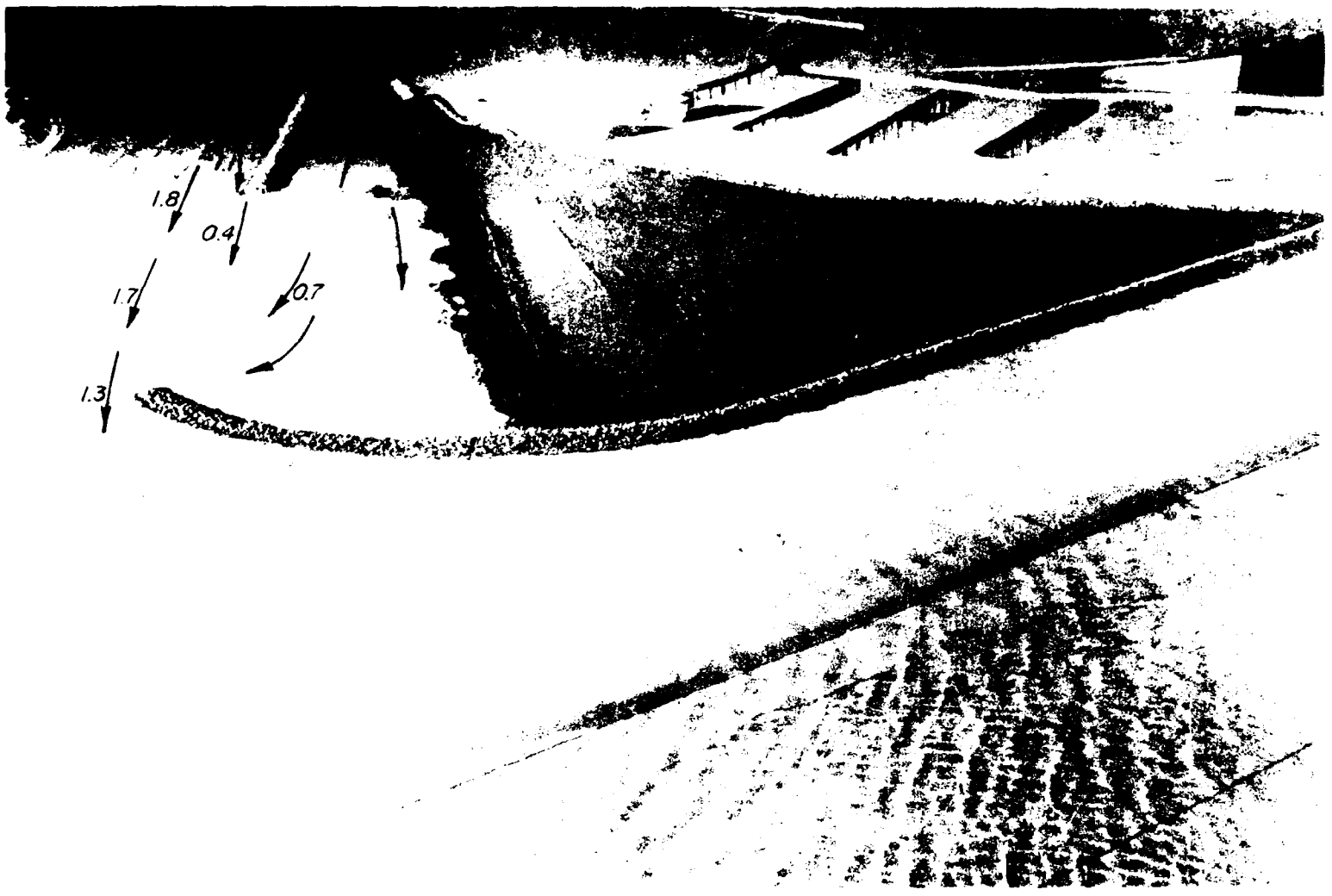


Photo 140. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 4B; 11-sec, 10-ft waves for maximum ebb; +3.7 ft swl

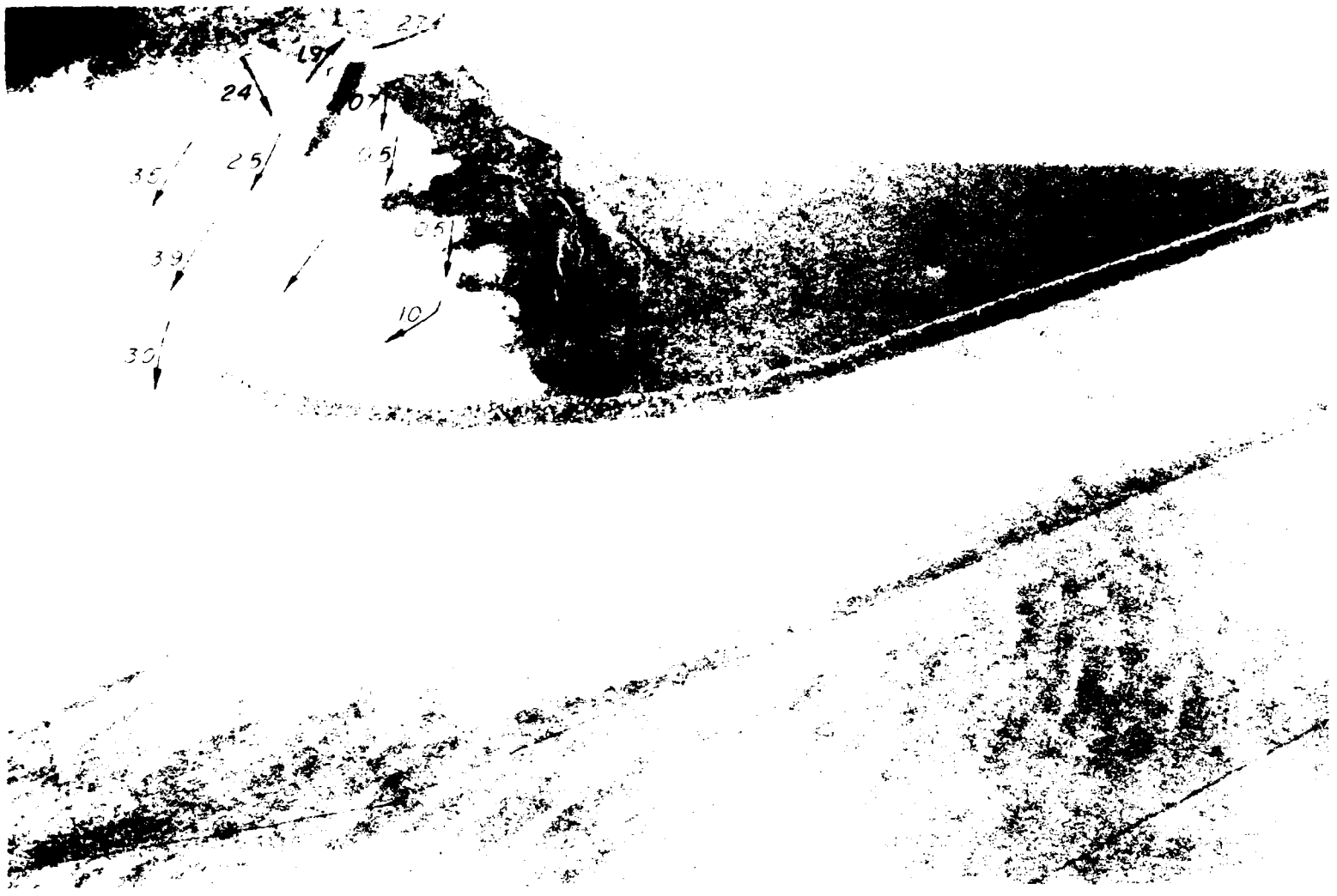
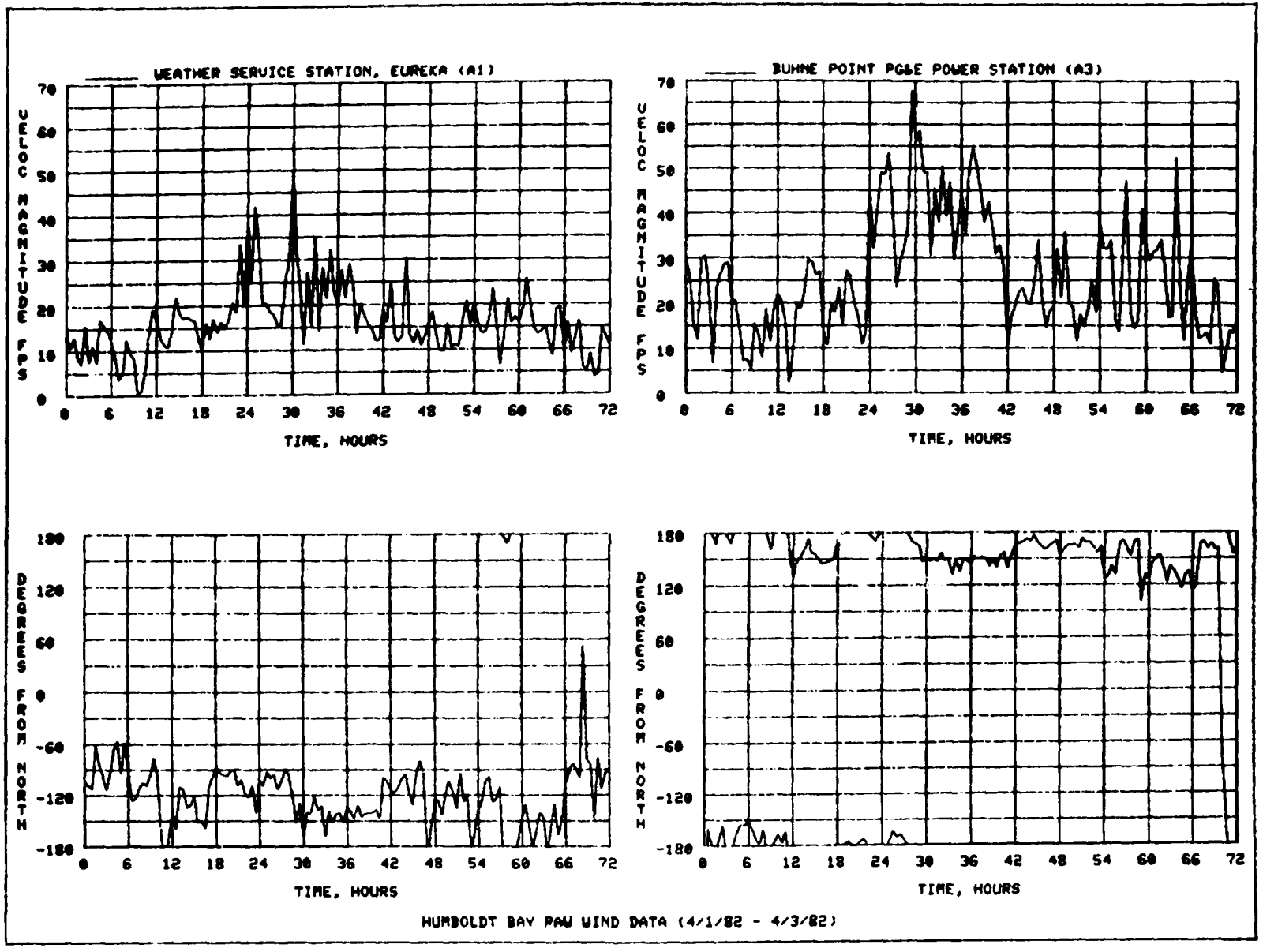


Photo 141. Typical wave patterns, current patterns, [illegible] current magnitudes (prototype feet per second) for Plan 4B; [illegible]

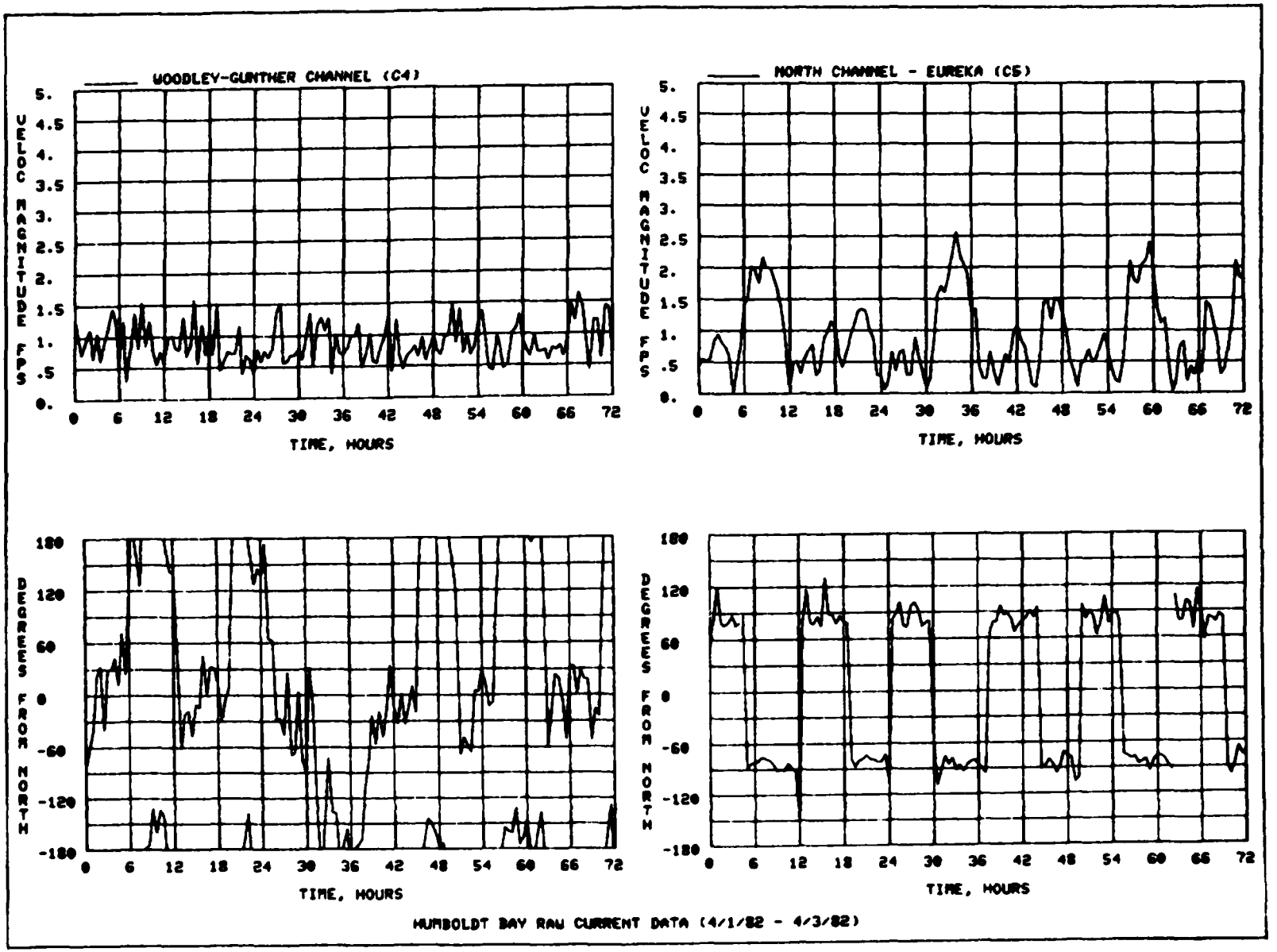
Photo 142. Typical wave patterns, current patterns, and current magnitudes (prototype feet per second) for Plan 4B; 11-sec, 10-ft waves; +9.5 ft swl



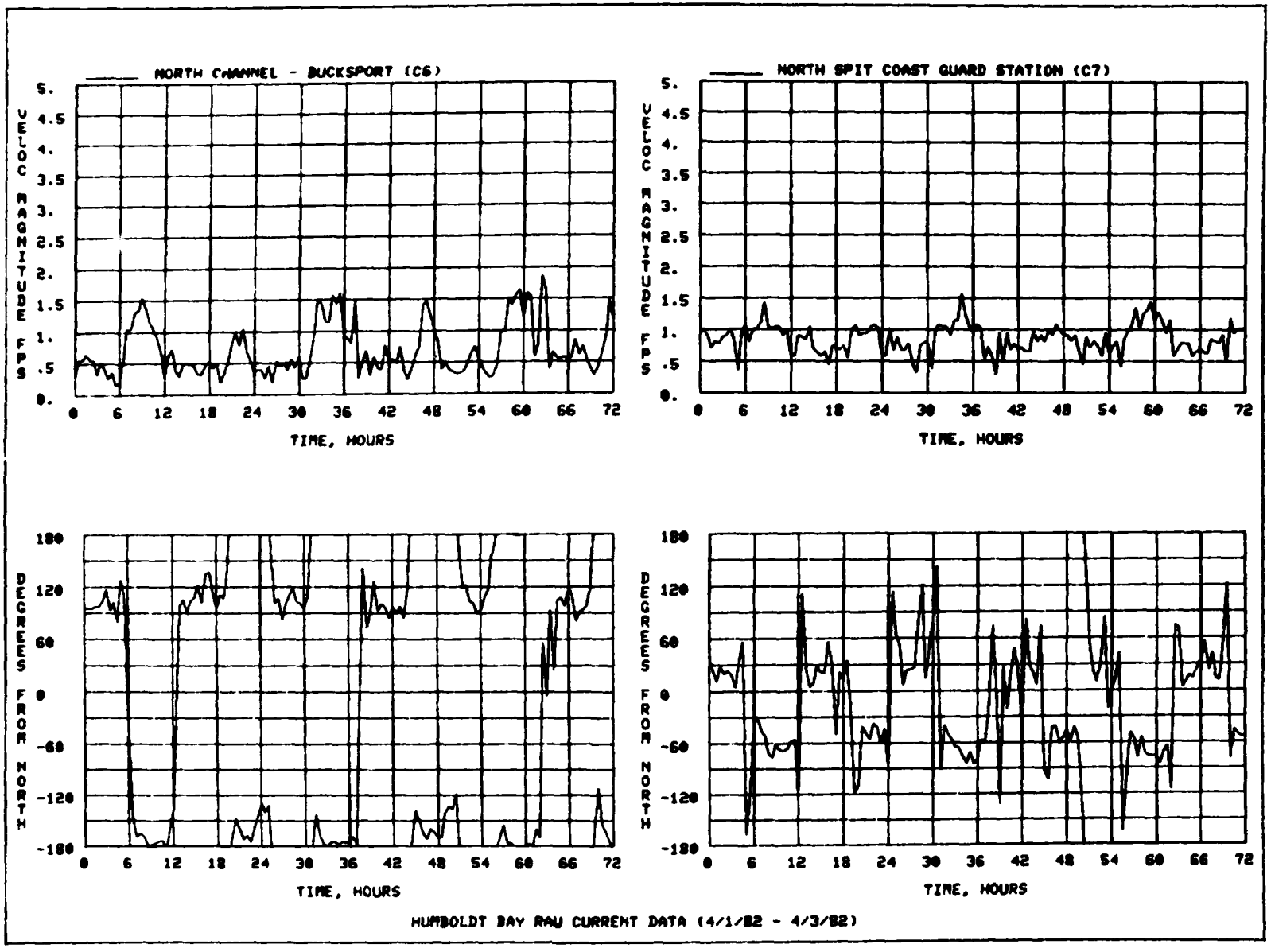
HUMBOLDT BAY PAW WIND DATA (4/1/82 - 4/3/82)

PLATE 1

PLATE 2



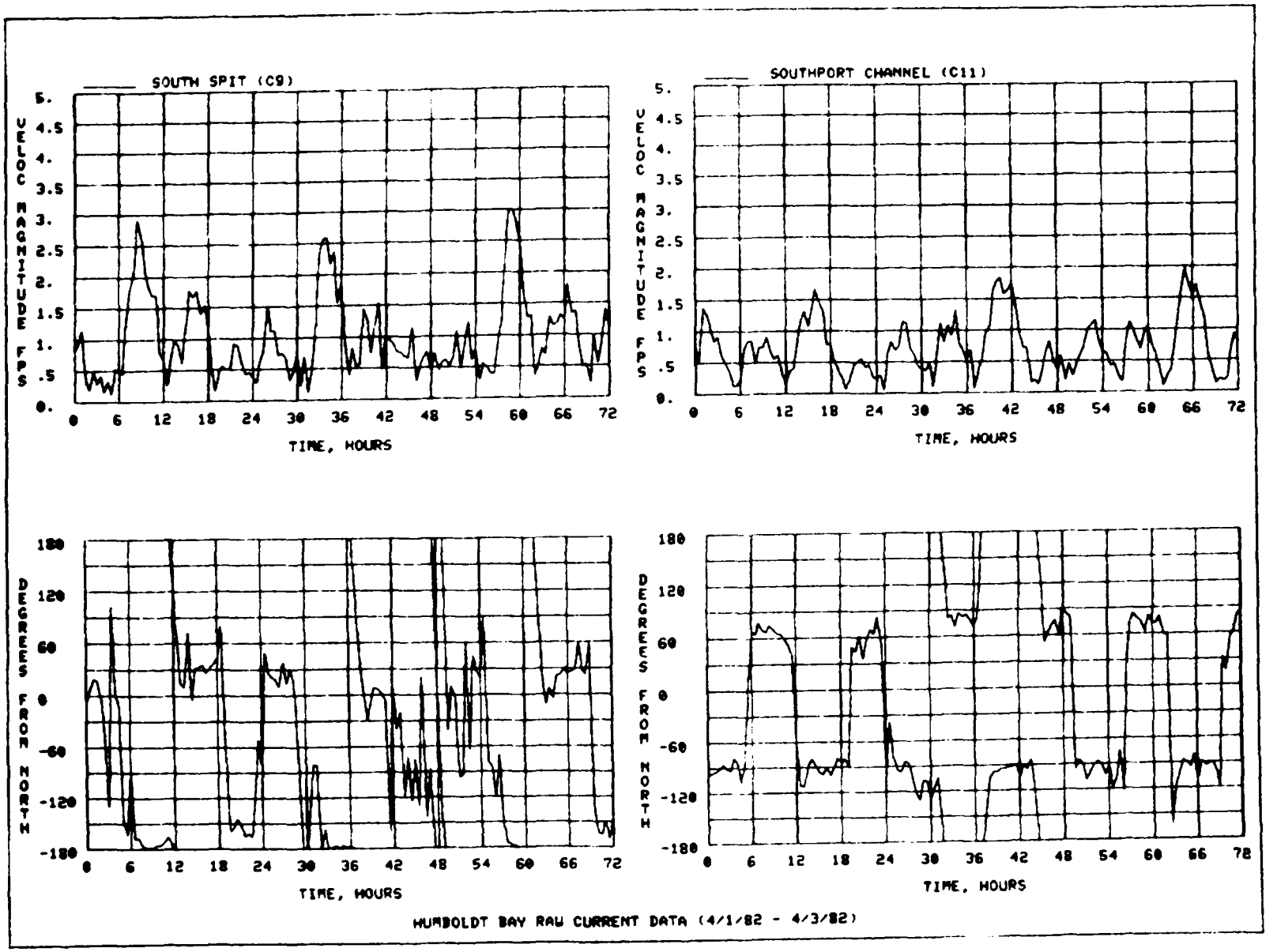
HUMBOLDT BAY RAW CURRENT DATA (4/1/82 - 4/3/82)



HUMBOLDT BAY RAU CURRENT DATA (4/1/82 - 4/3/82)

PLATE 3

PLATE 4



HUMBOLDT BAY RAW CURRENT DATA (4/1/82 - 4/3/82)

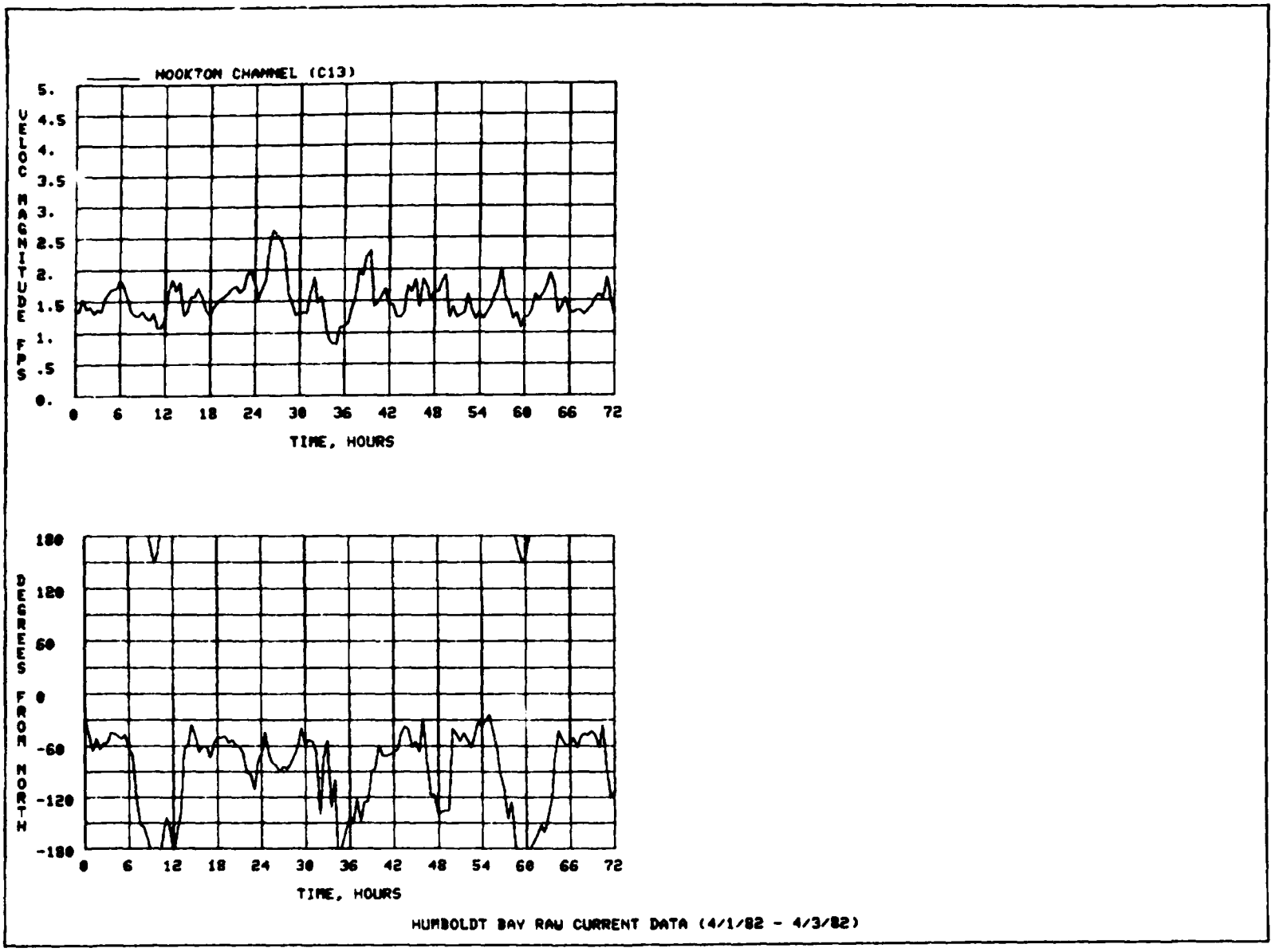
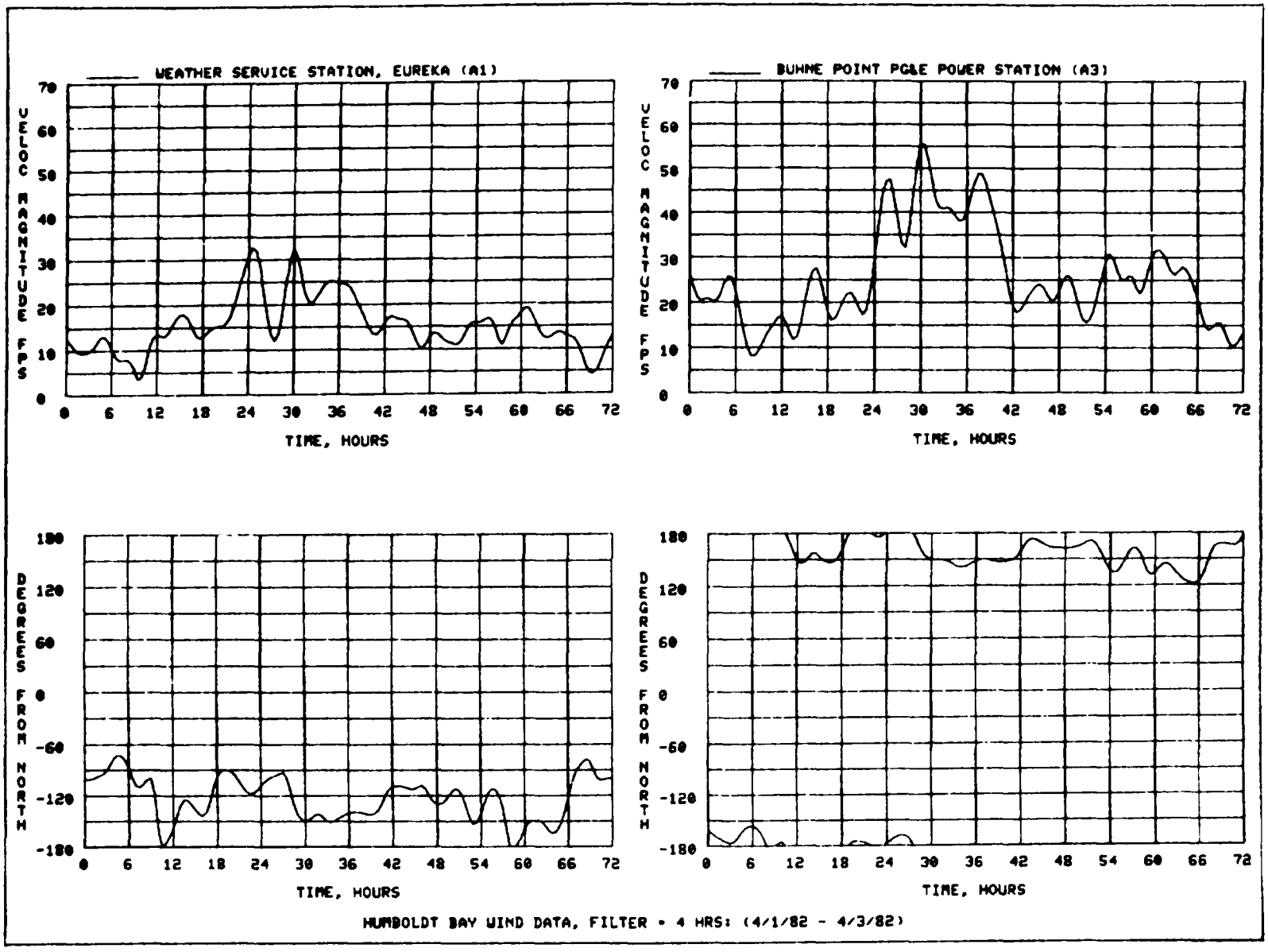
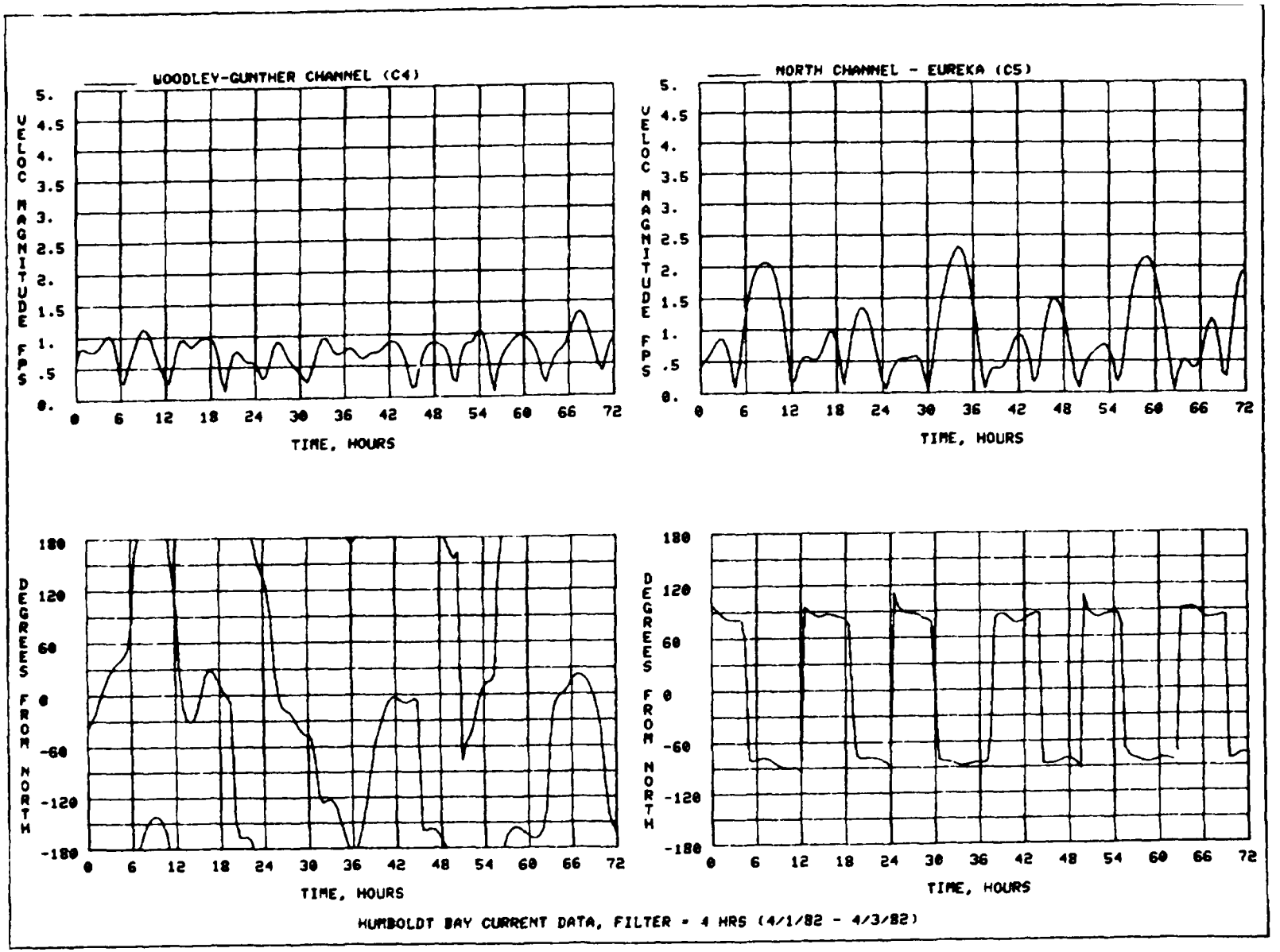

HOOKTON CHANNEL (C13)
VELOC MAGNITUDE FPS
5.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
0.
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
180
120
60
0
-60
-120
-180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
HUMBOLDT BAY RAW CURRENT DATA (4/1/82 - 4/3/82)

PLATE 5

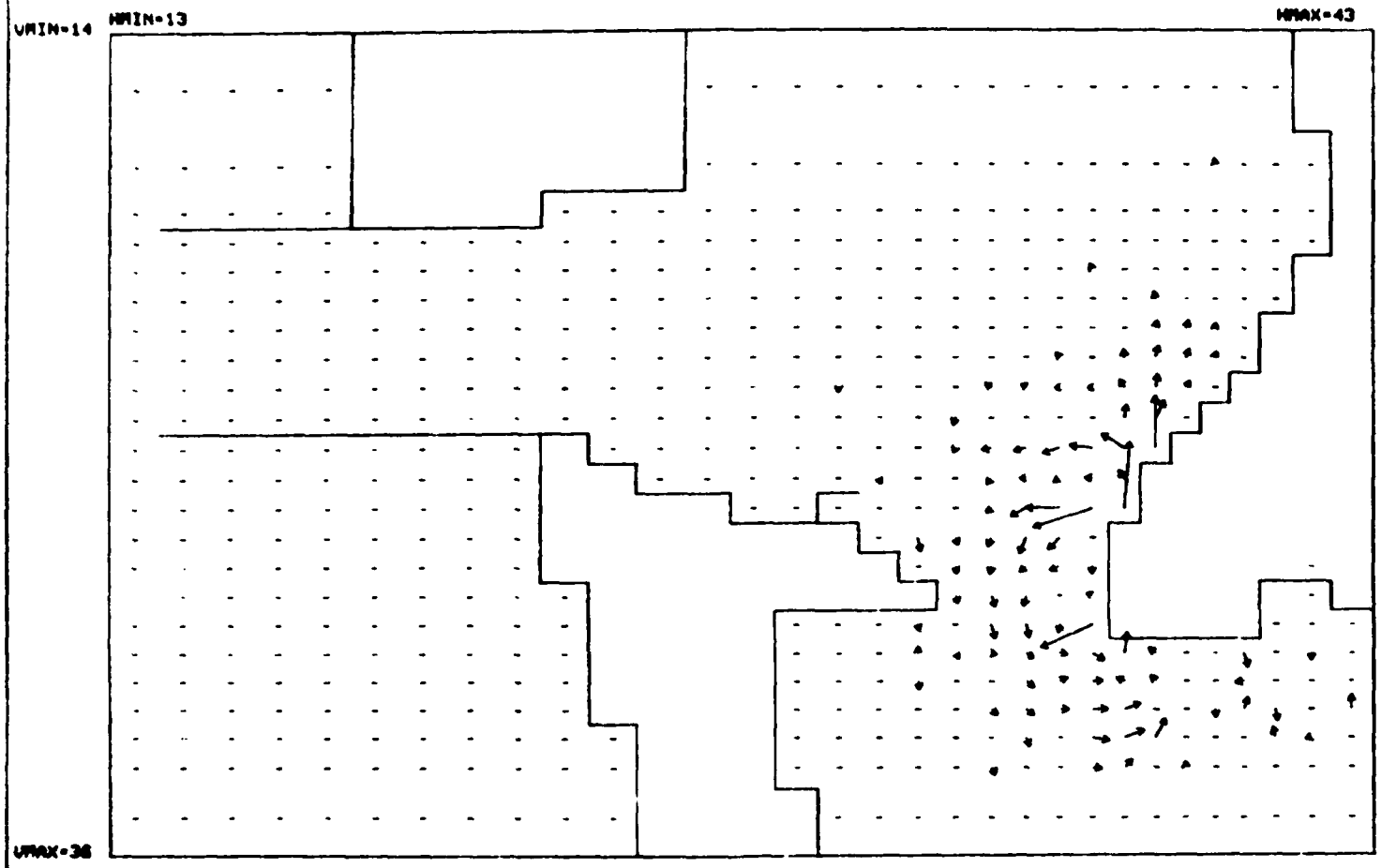
PLATE 6


WEATHER SERVICE STATION, EUREKA (A1)
VELOC MAGNITUDE FPS
0
10
20
30
40
50
60
70
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
BUHNE POINT PG&E POWER STATION (A3)
VELOC MAGNITUDE FPS
0
10
20
30
40
50
60
70
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
-180
-120
-60
0
60
120
180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
-180
-120
-60
0
60
120
180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
HUMBOLDT BAY WIND DATA, FILTER = 4 HRS: (4/1/82 - 4/3/82)



HUMBOLDT BAY CURRENT DATA, FILTER = 4 HRS (4/1/82 - 4/3/82)

PLATE 7



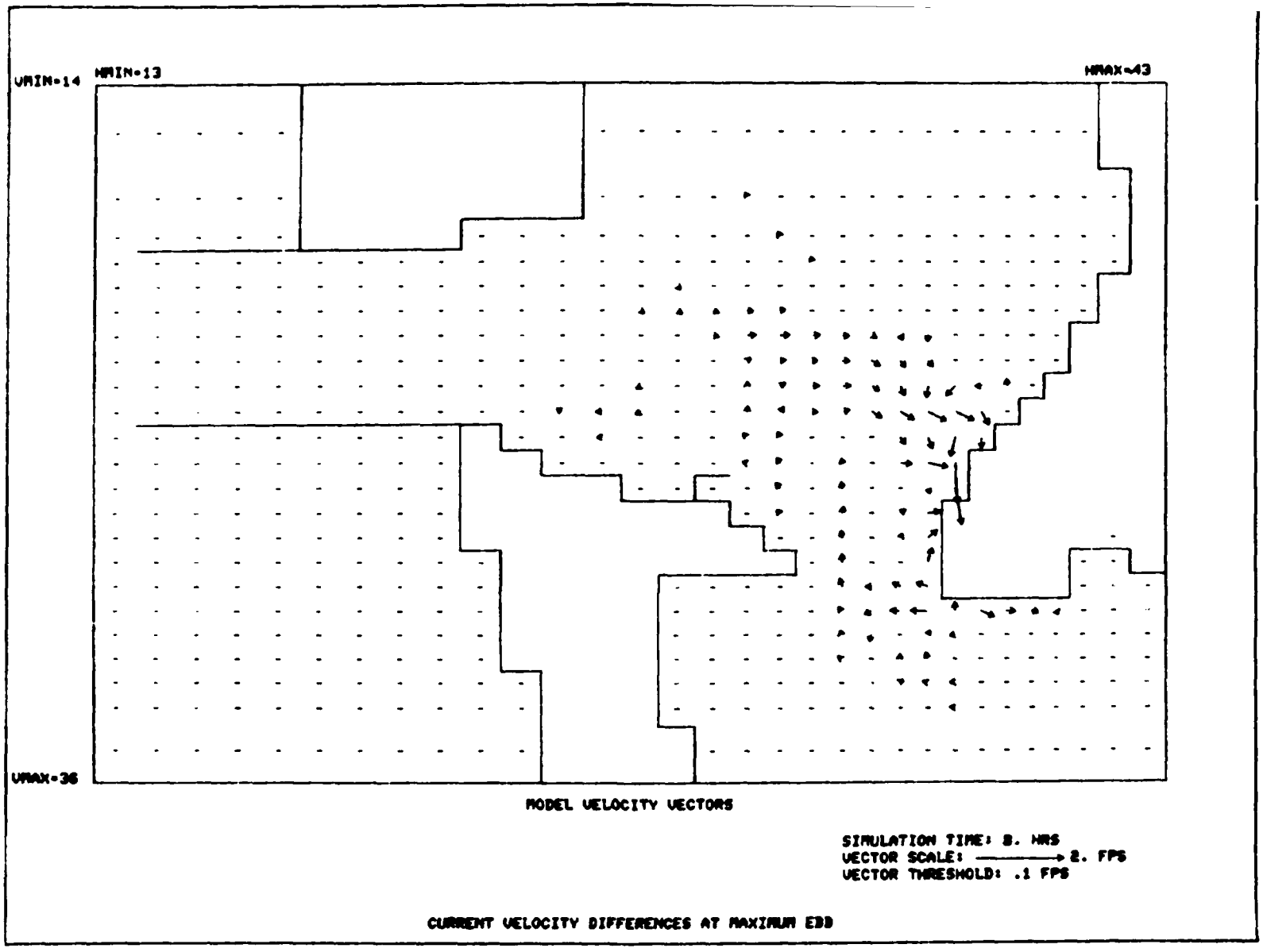
MODEL VELOCITY VECTORS

SIMULATION TIME: 16. HRS
VECTOR SCALE: ——→ 2. FPS
VECTOR THRESHOLD: .1 FPS

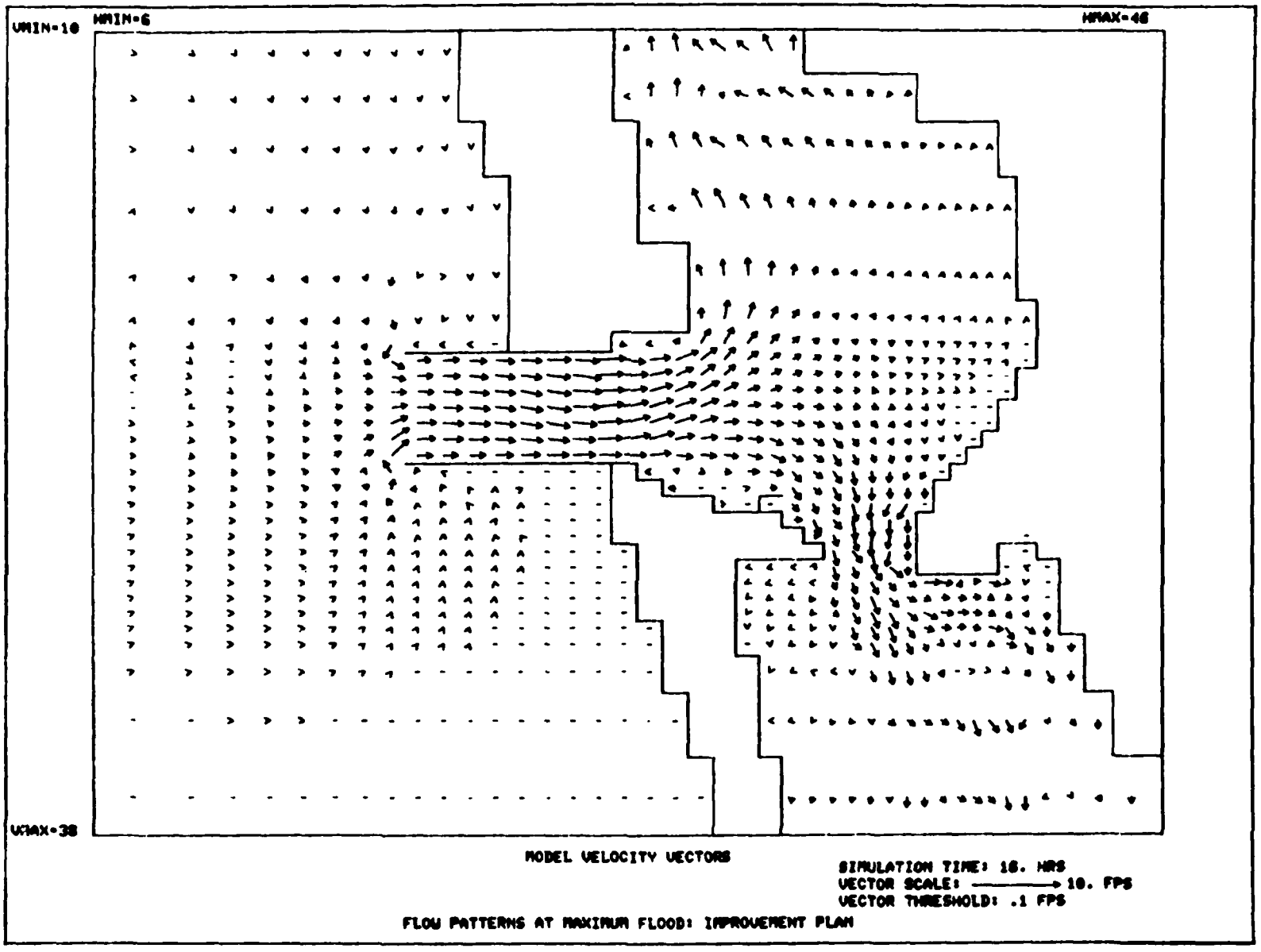
CURRENT VELOCITY DIFFERENCES AT MAXIMUM FLOOD

PLATE 21

PLATE 20



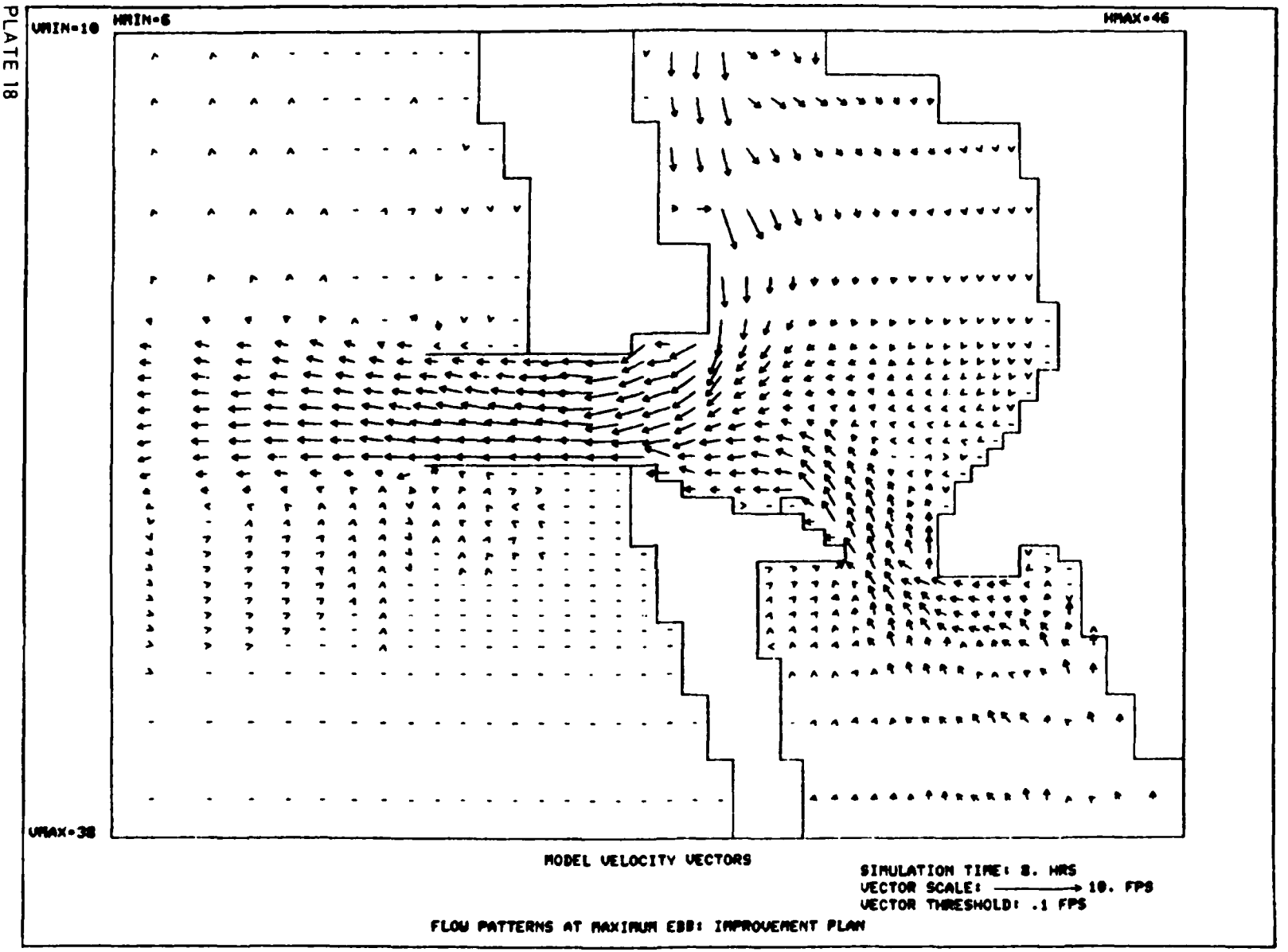
CURRENT VELOCITY DIFFERENCES AT MAXIMUM EBB



FLOW PATTERNS AT MAXIMUM FLOOD: IMPROVEMENT PLAN

PLATE 19

PLATE 18



FLOW PATTERNS AT MAXIMUM EBB: IMPROVEMENT PLAN

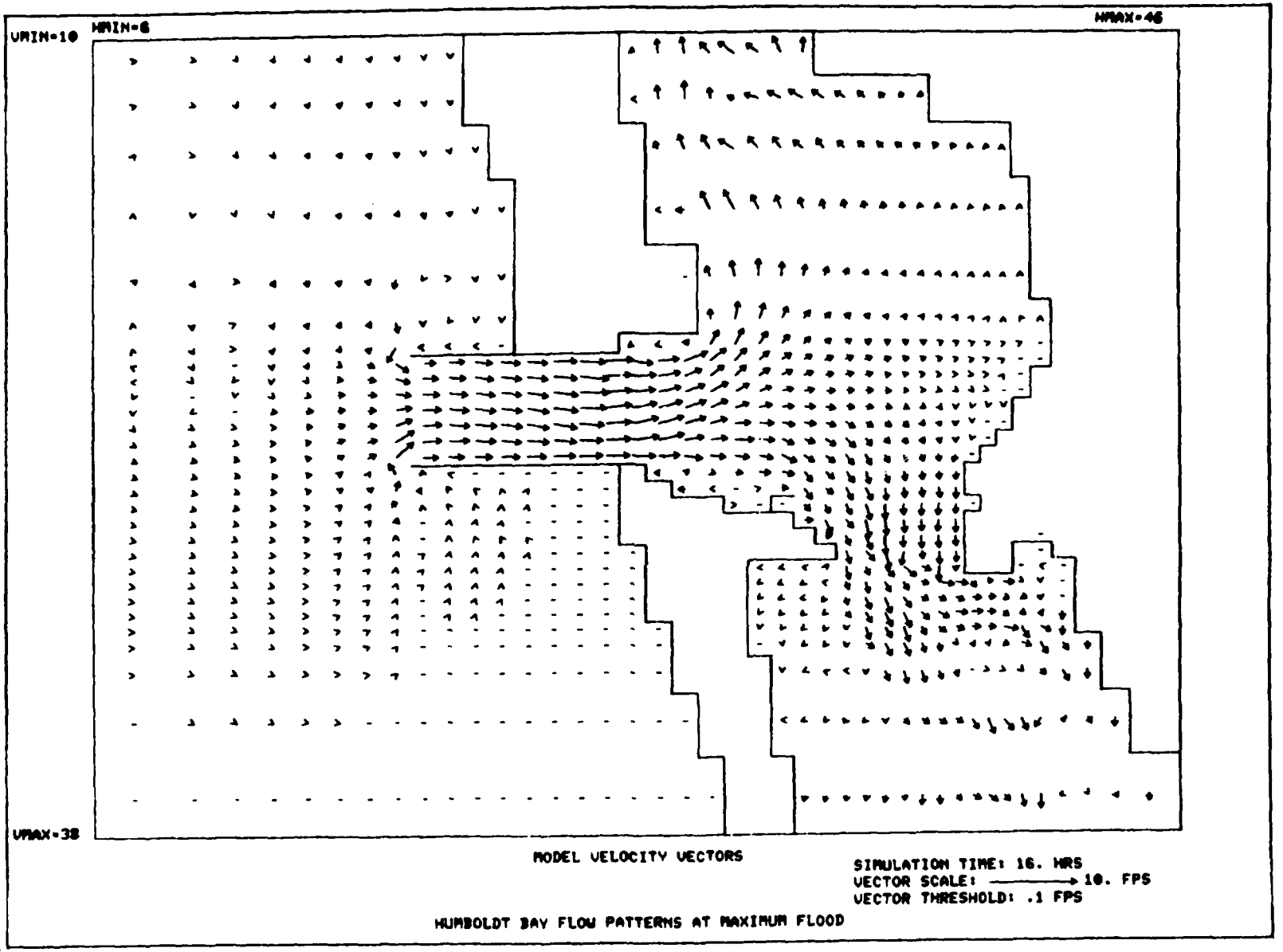
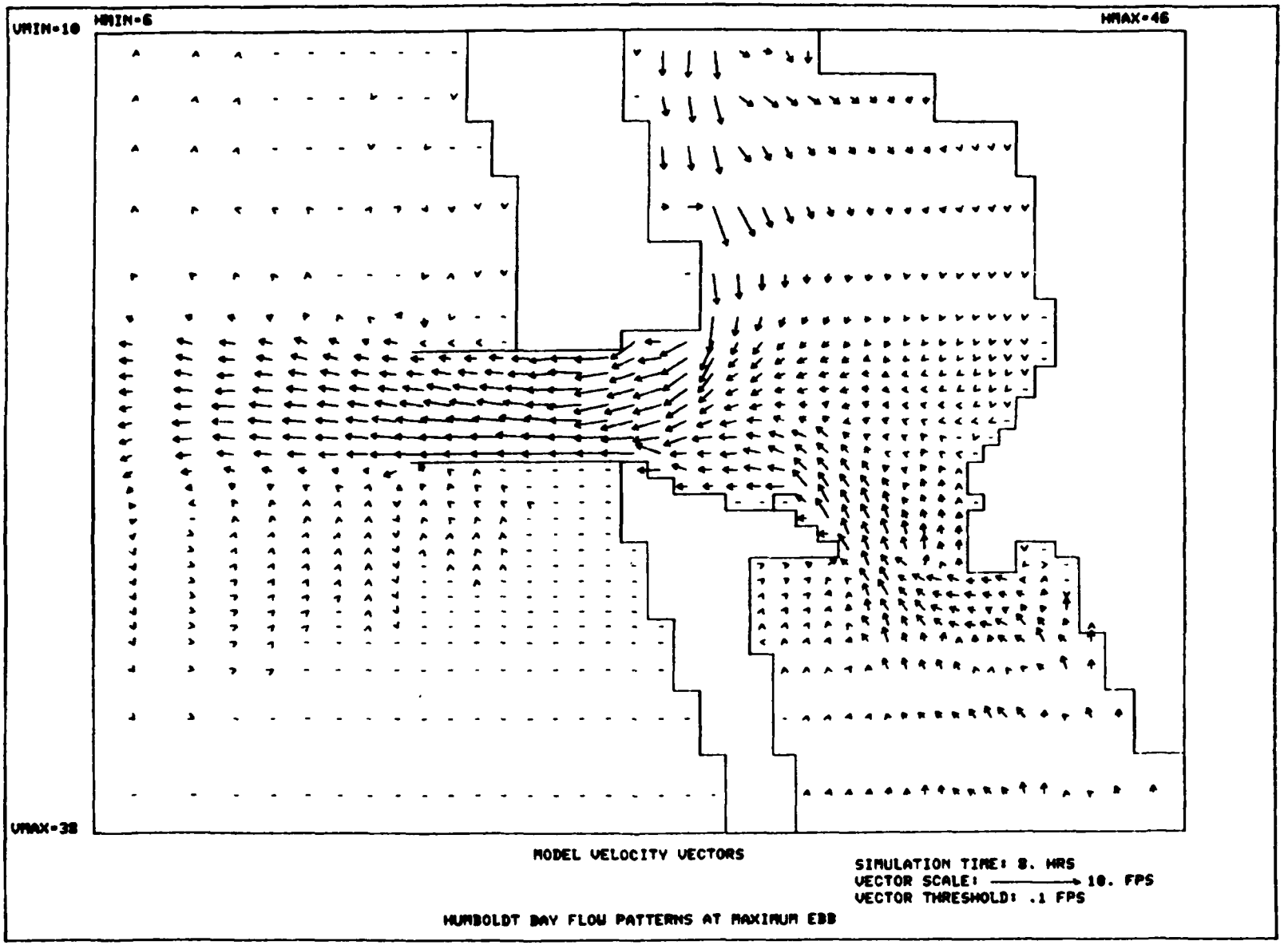

VMIN=10
MMIN=6
MMAX=46
VMAX=38
MODEL VELOCITY VECTORS
SIMULATION TIME: 16. HRS
VECTOR SCALE: ——→ 10. FPS
VECTOR THRESHOLD: .1 FPS
HUMBOLDT BAY FLOW PATTERNS AT MAXIMUM FLOOD

PLATE 17

PLATE 16


UMIN=10
HMIN=6
HMAX=46
UMAX=38
MODEL VELOCITY VECTORS
SIMULATION TIME: 8. HRS
VECTOR SCALE: ——→ 10. FPS
VECTOR THRESHOLD: .1 FPS
HUMBOLDT BAY FLOW PATTERNS AT MAXIMUM EBB

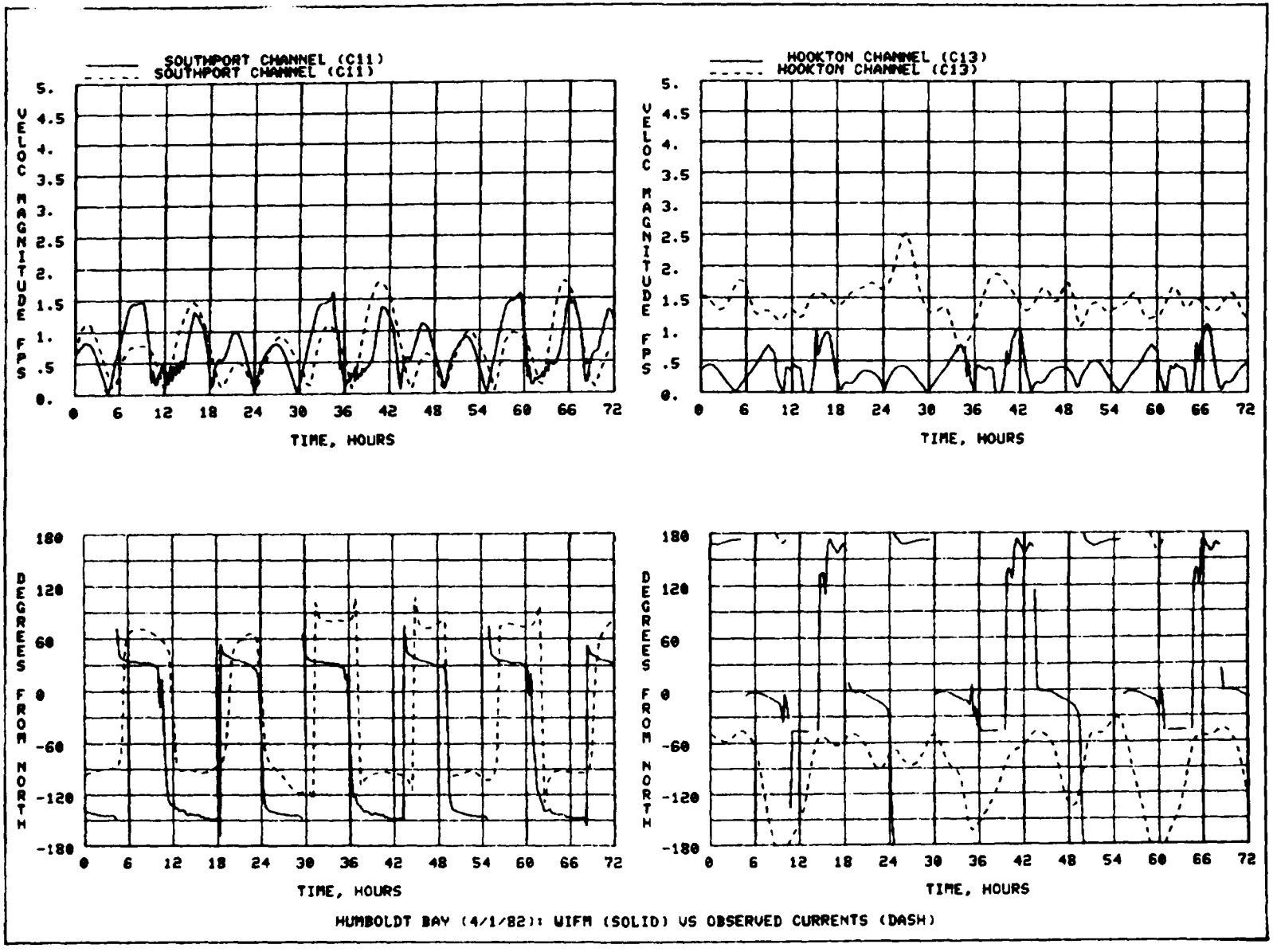
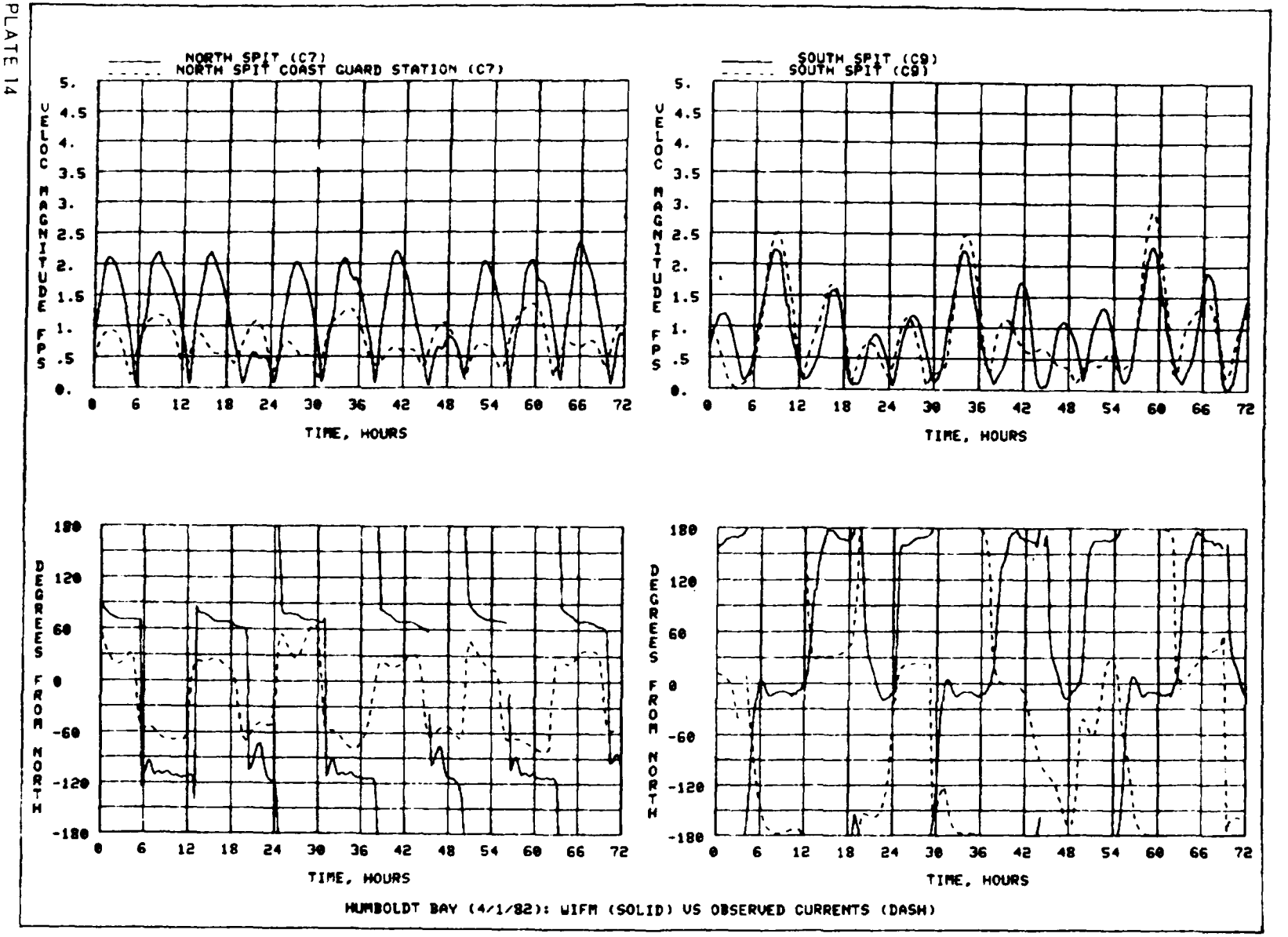
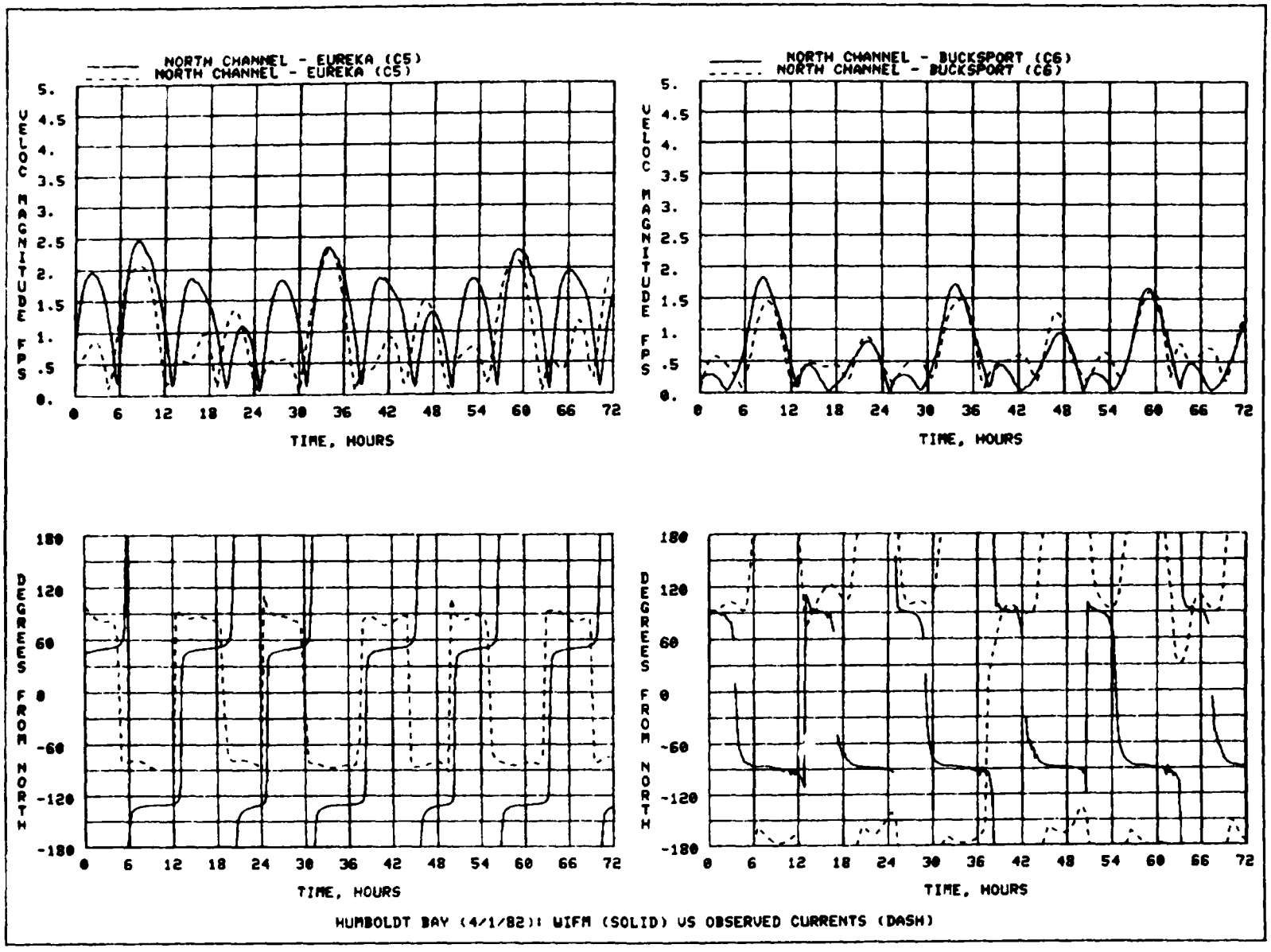

SOUTHPORT CHANNEL (C11)
SOUTHPORT CHANNEL (C11)
VELOC MAGNITUDE FPS
TIME, HOURS
HOOKTON CHANNEL (C13)
HOOKTON CHANNEL (C13)
VELOC MAGNITUDE FPS
TIME, HOURS
DEGREES FROM NORTH
TIME, HOURS
DEGREES FROM NORTH
TIME, HOURS
HUMBOLDT BAY (4/1/82): WIFM (SOLID) VS OBSERVED CURRENTS (DASH)

PLATE 15

PLATE 14



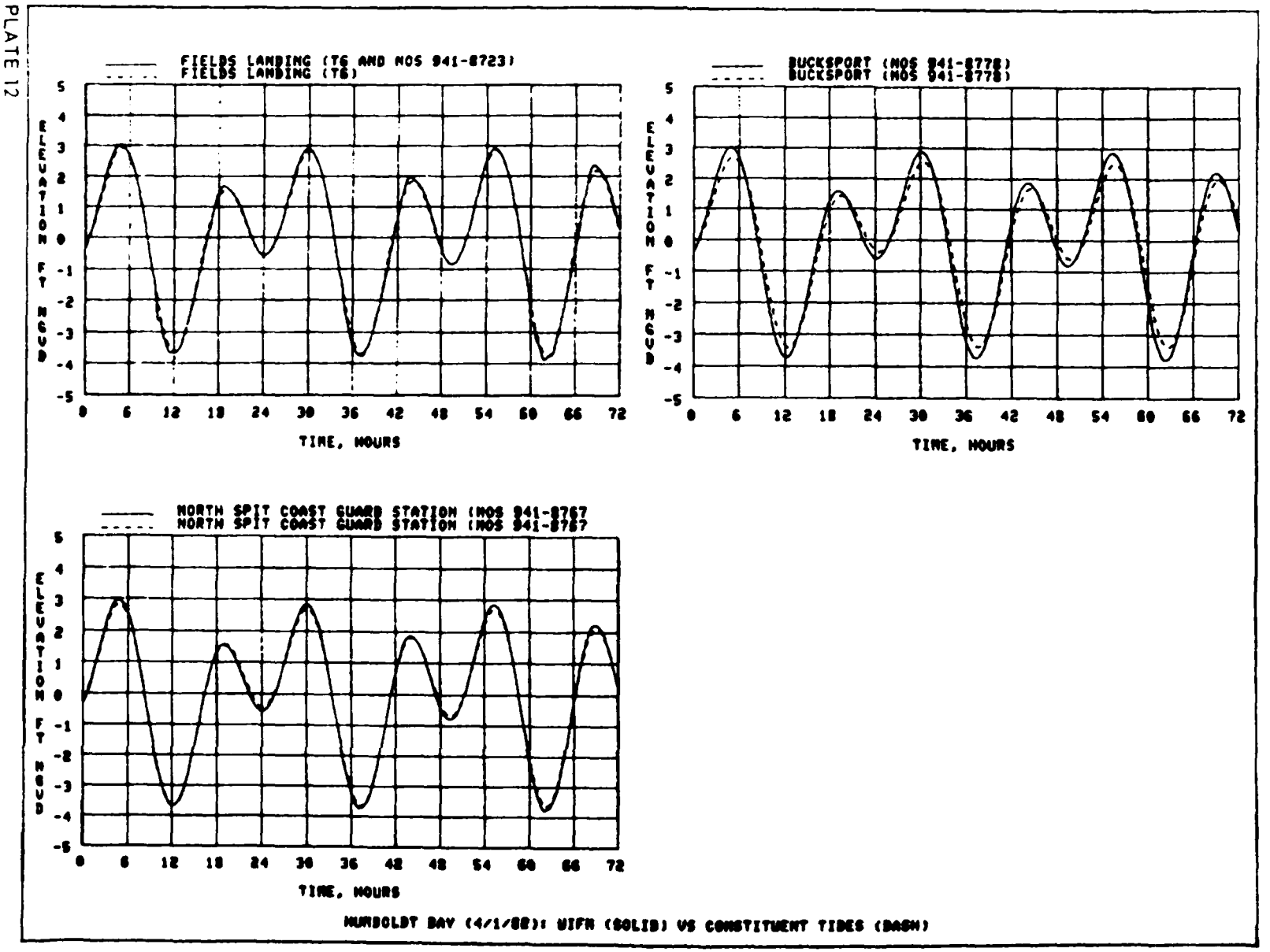
HUMBOLDT BAY (4/1/82): WIFM (SOLID) VS OBSERVED CURRENTS (DASH)

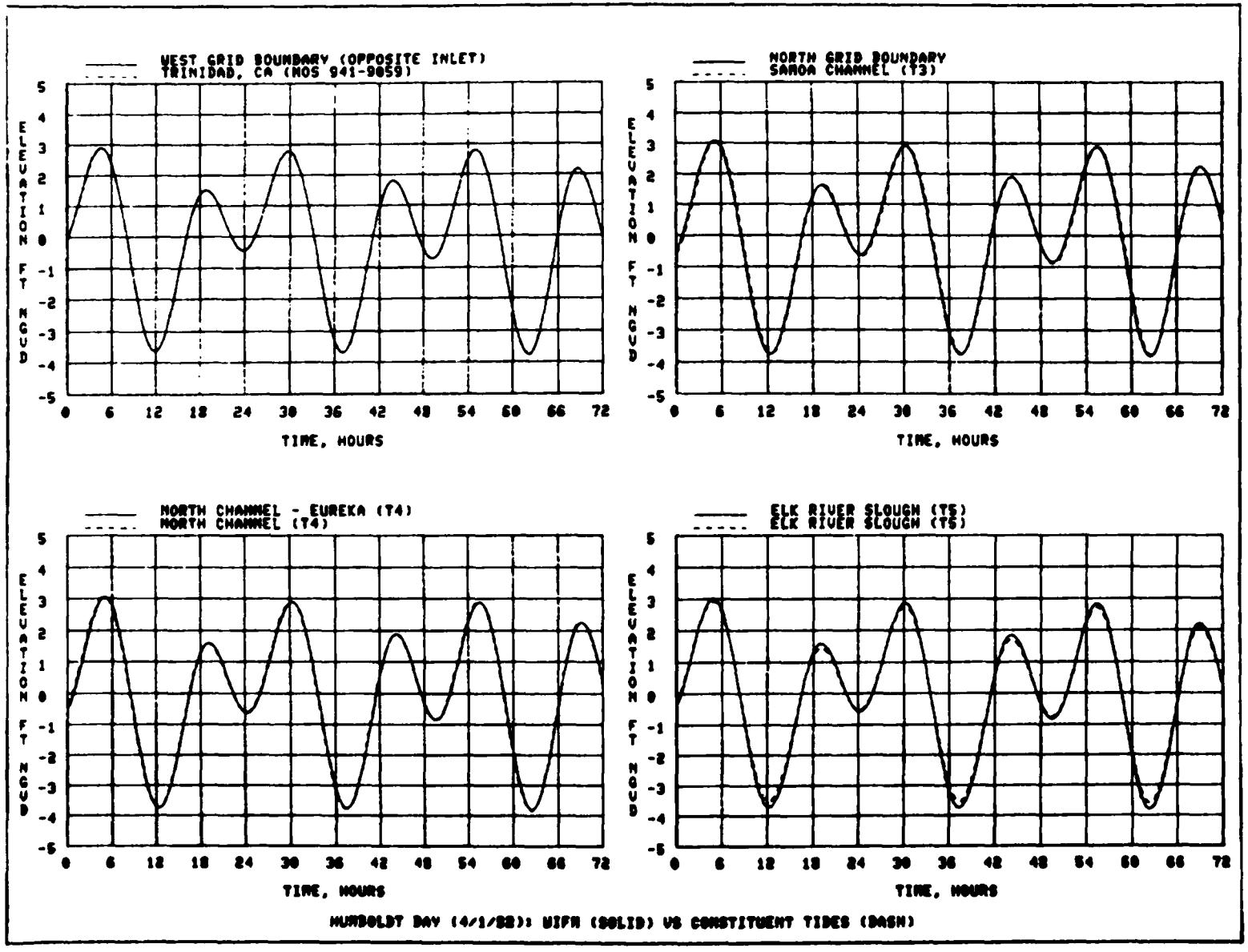


HUMBOLDT BAY (4/1/82): WIFM (SOLID) VS OBSERVED CURRENTS (DASH)

PLATE 13

PLATE 12

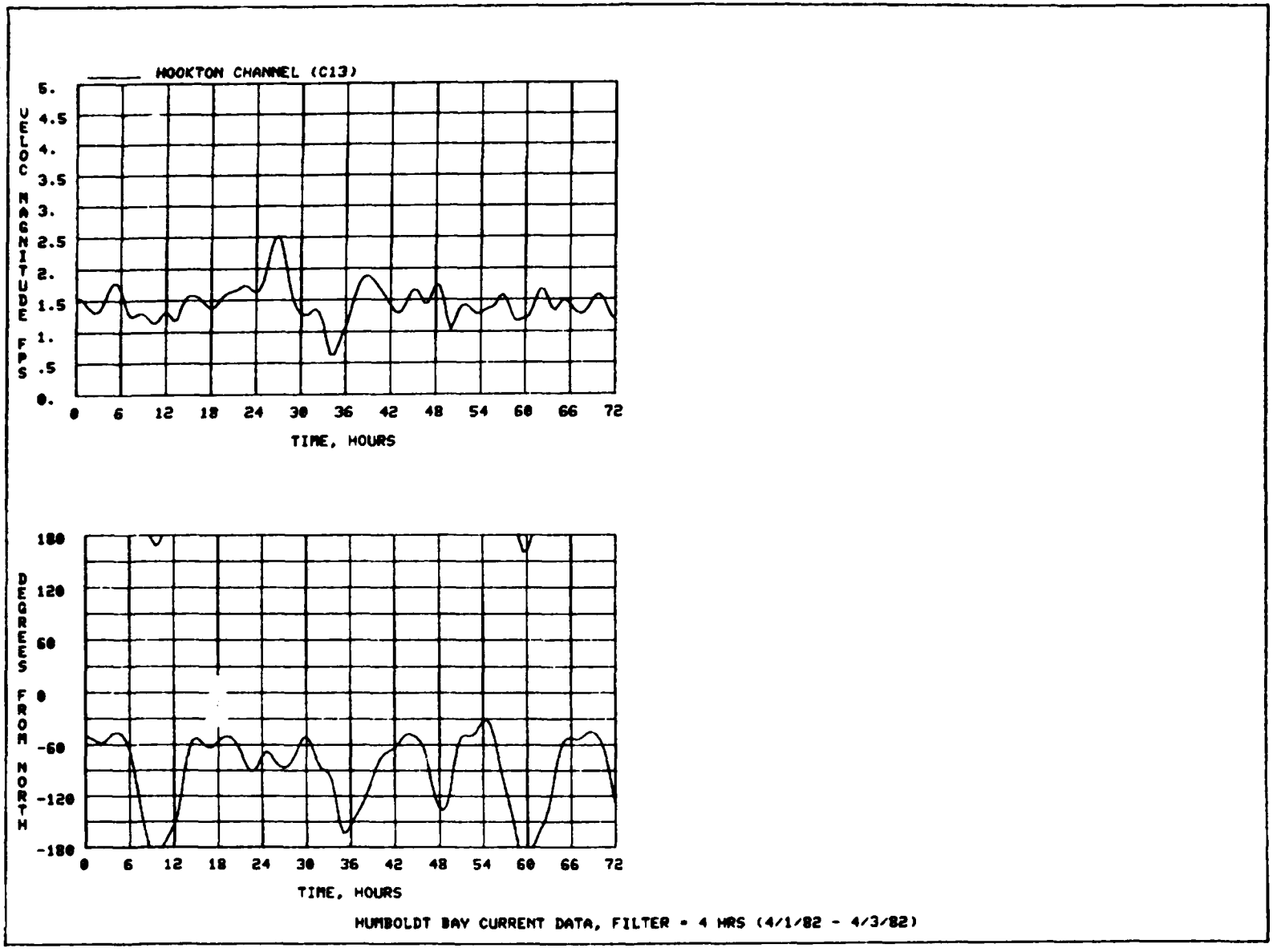

FIELDS LANDING (TG AND NOS 941-8723)
FIELDS LANDING (TG)
ELEVATION FT MSLD
TIME, HOURS
BUCKSPORT (NOS 941-8778)
BUCKSPORT (NOS 941-8778)
ELEVATION FT MSLD
TIME, HOURS
NORTH SPIT COAST GUARD STATION (NOS 941-8767
NORTH SPIT COAST GUARD STATION (NOS 941-8767
ELEVATION FT MSLD
TIME, HOURS
HUMBOLDT BAY (4/1/82): UIFM (SOLID) VS CONSTITUENT TIDES (DASH)



HUMBOLDT BAY (4/1/82): NIFH (SOLID) VS CONSTITUENT TIDES (DASH)

PLATE 11

PLATE 10


HOOKTON CHANNEL (C13)
VELOC MAGNITUDE FPS
5.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
0.
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
180
120
60
0
-60
-120
-180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
HUMBOLDT BAY CURRENT DATA, FILTER = 4 HRS (4/1/82 - 4/3/82)

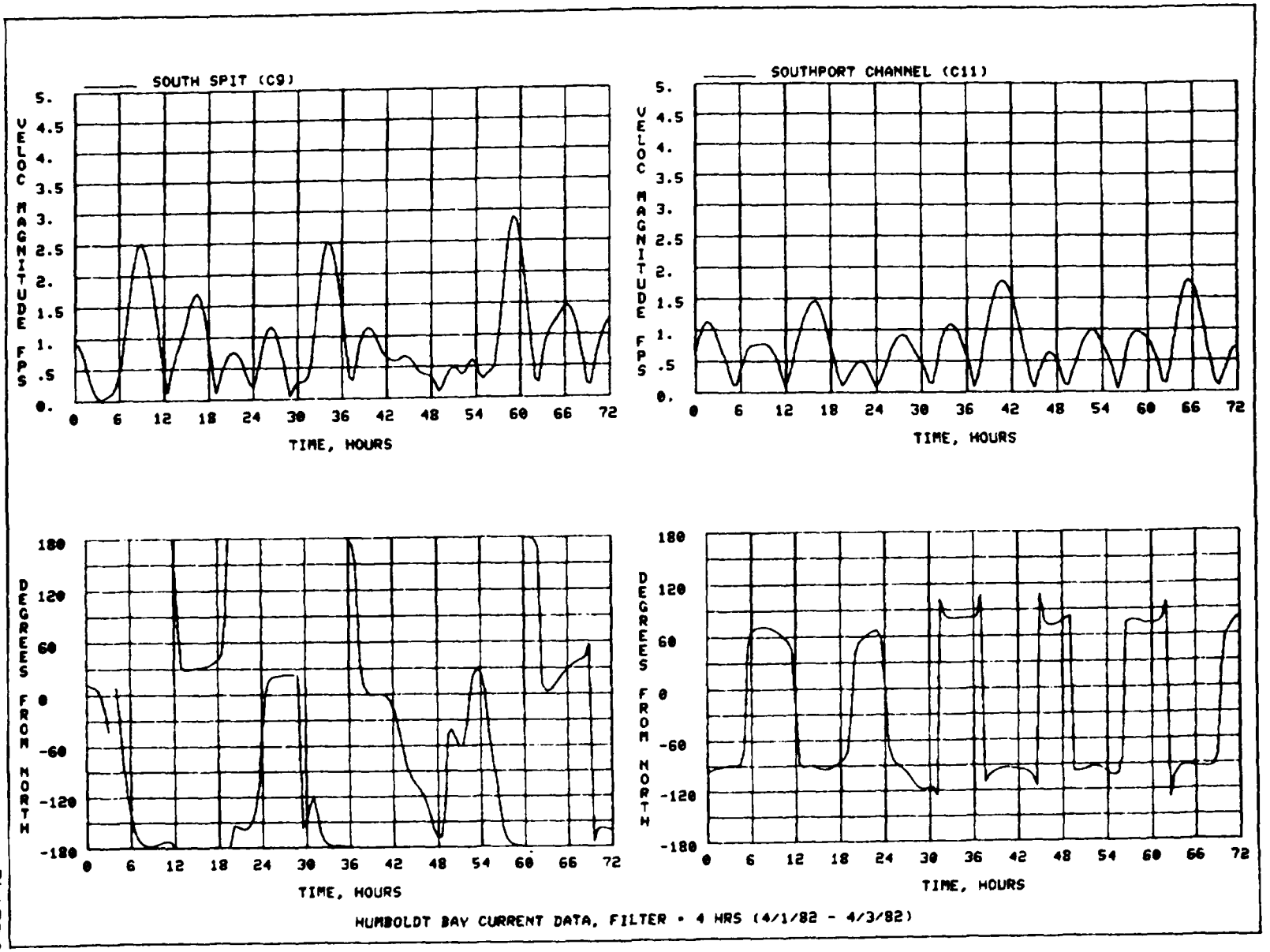

SOUTH SPIT (C9)
VELOC MAGNITUDE FPS
5.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
0.
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
SOUTHPORT CHANNEL (C11)
VELOC MAGNITUDE FPS
5.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
0.
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
180
120
60
0
-60
-120
-180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
180
120
60
0
-60
-120
-180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
HUMBOLDT BAY CURRENT DATA, FILTER = 4 HRS (4/1/82 - 4/3/82)

PLATE 9

PLATE 8

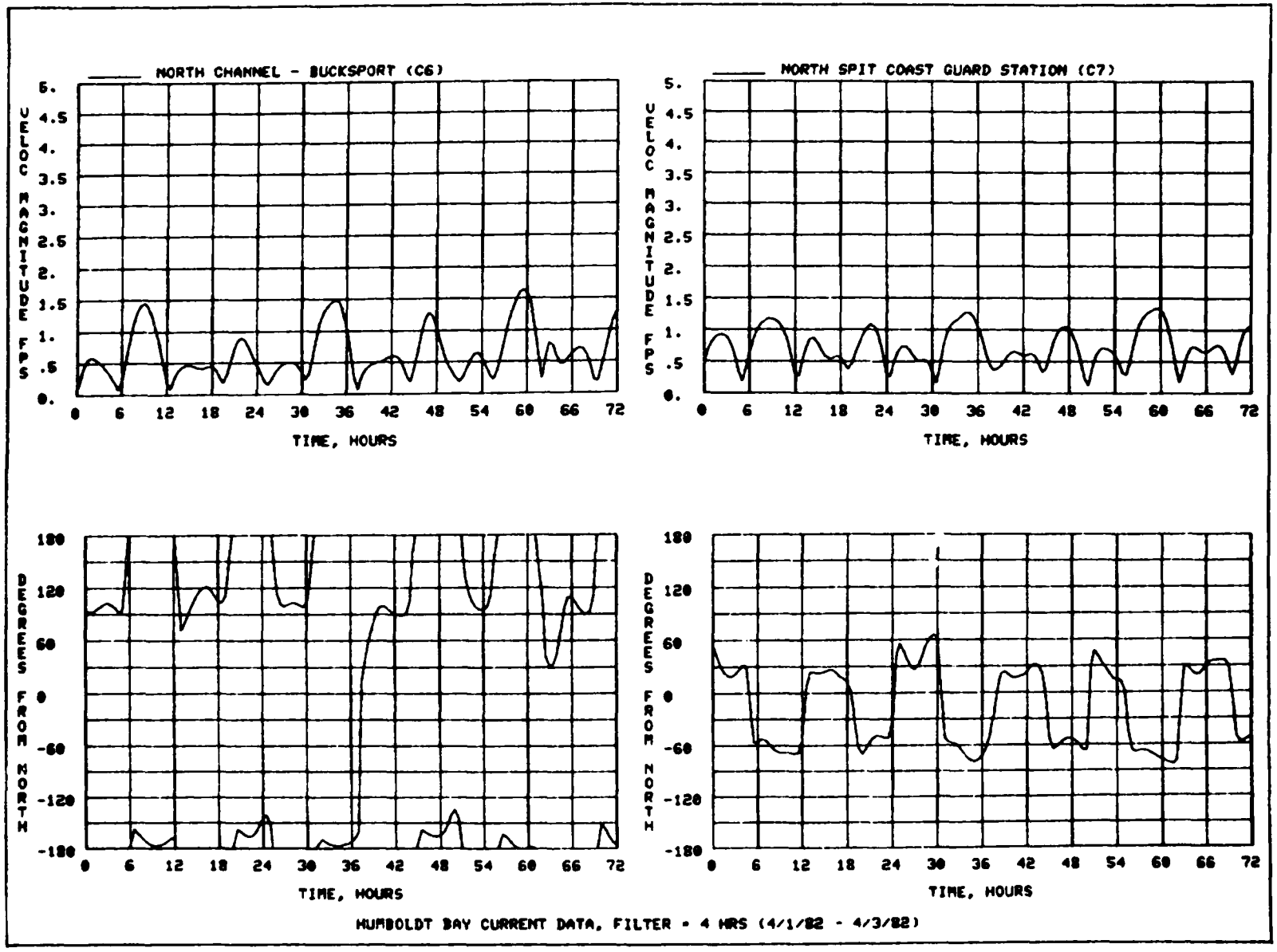
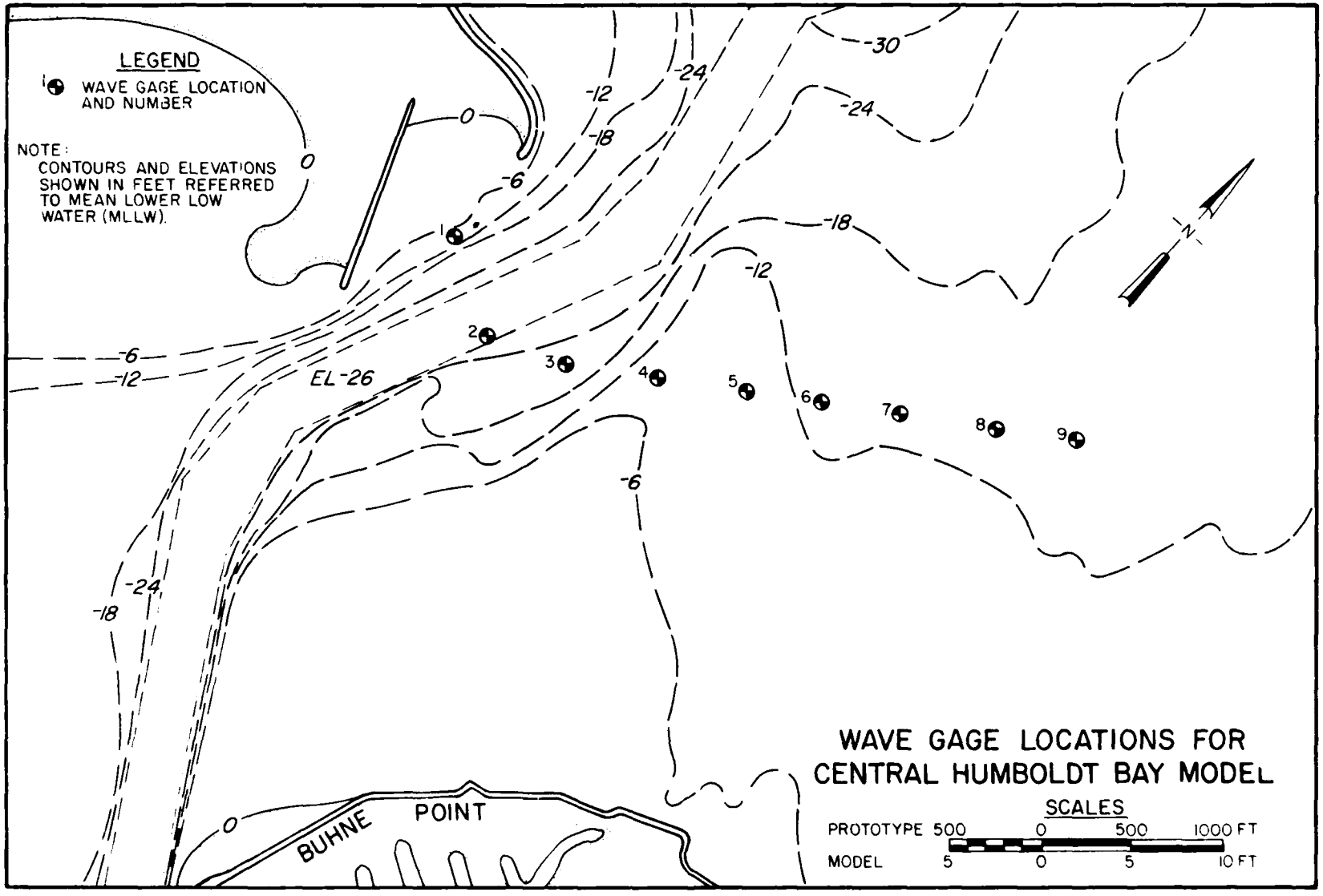

NORTH CHANNEL - BUCKSPORT (C6)
VELOC MAGNITUDE FPS
6.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
0.
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
NORTH SPIT COAST GUARD STATION (C7)
VELOC MAGNITUDE FPS
5.
4.5
4.
3.5
3.
2.5
2.
1.5
1.
.5
0.
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
180
120
60
0
-60
-120
-180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
DEGREES FROM NORTH
180
120
60
0
-60
-120
-180
0 6 12 18 24 30 36 42 48 54 60 66 72
TIME, HOURS
HUMBOLDT BAY CURRENT DATA, FILTER = 4 HRS (4/1/82 - 4/3/82)

PLATE 22


LEGEND
WAVE GAGE LOCATION AND NUMBER
NOTE:
CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW).
0
-6
-12
-18
-24
-30
EL -26
1
2
3
4
5
6
7
8
9
N
BUHNE POINT
WAVE GAGE LOCATIONS FOR CENTRAL HUMBOLDT BAY MODEL
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 5 0 5 10 FT

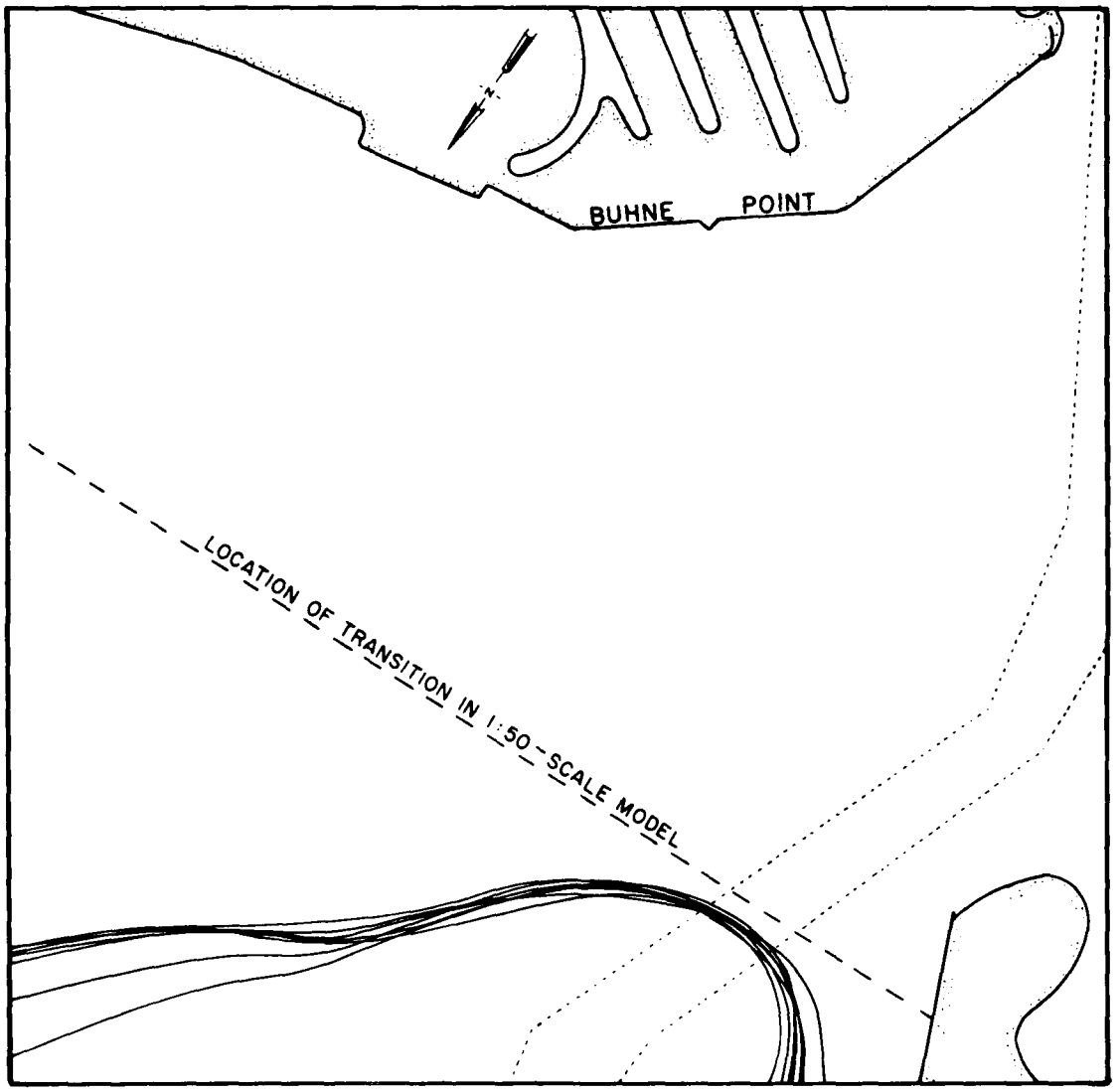


Plate 23. Wave fronts for test waves approaching Buhne Point from north; 0.0-ft swl

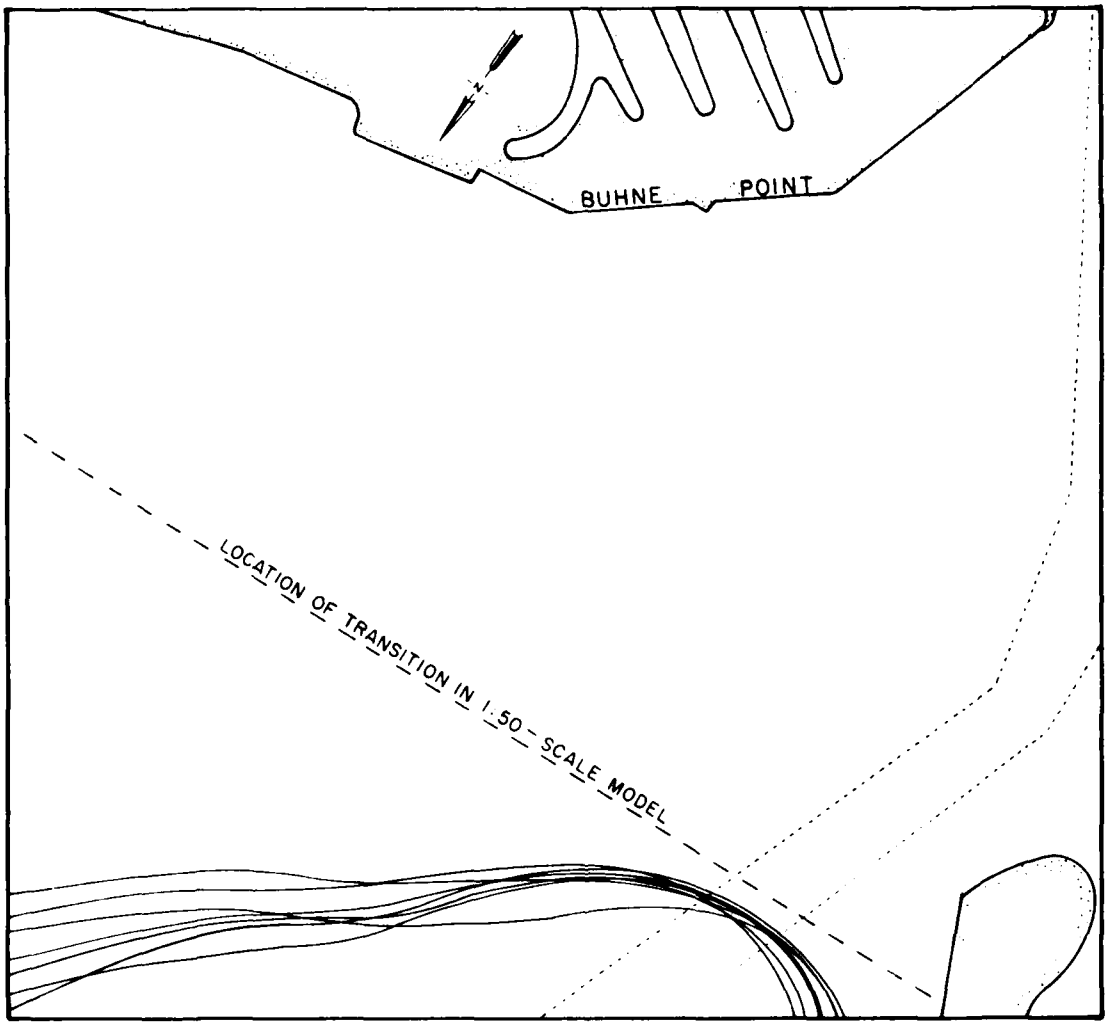


Plate 24. Wave fronts for test waves approaching Buhne Point from north for maximum flood; +3.2 ft swl

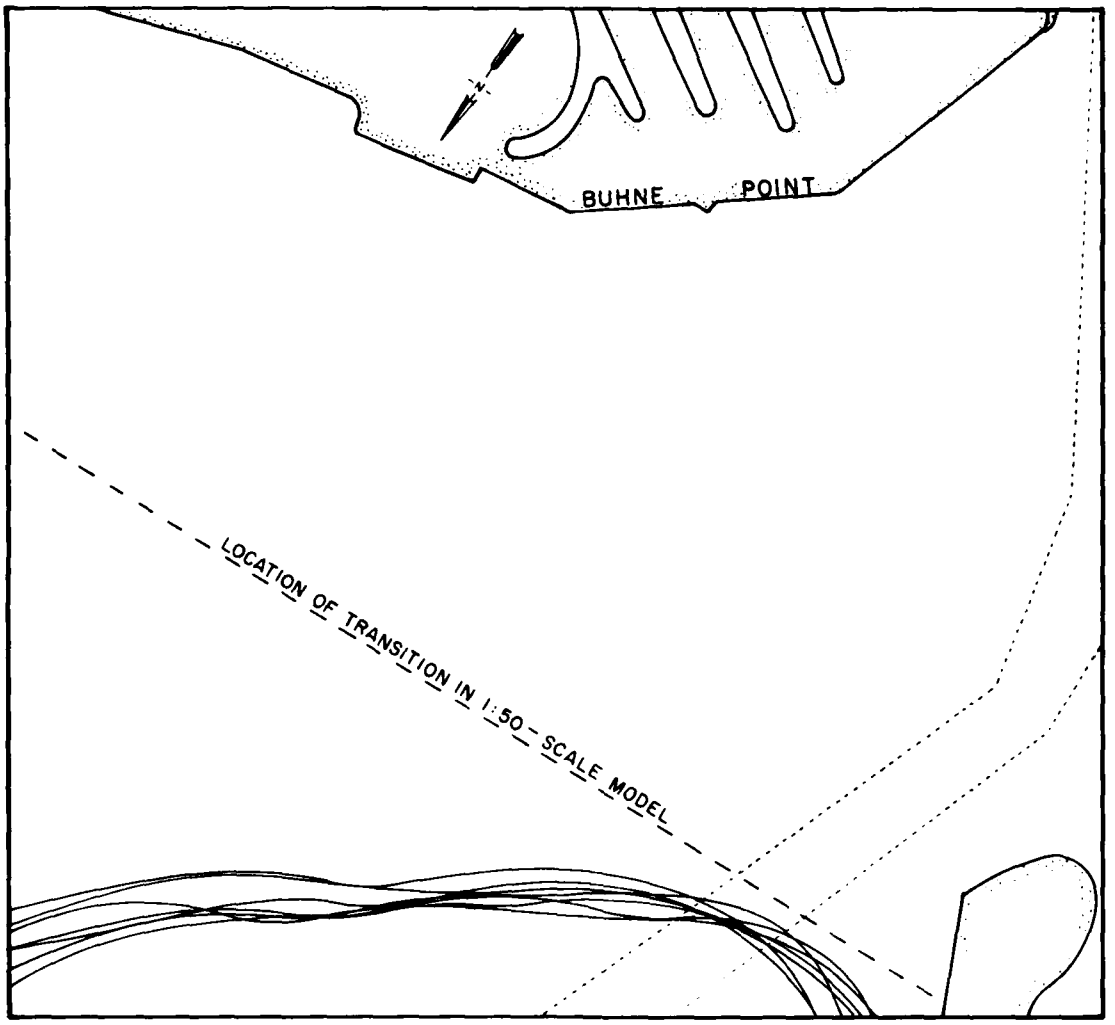


Plate 25. Wave fronts for test waves approaching Buhne Point from north for maximum ebb; +3.7 ft swl

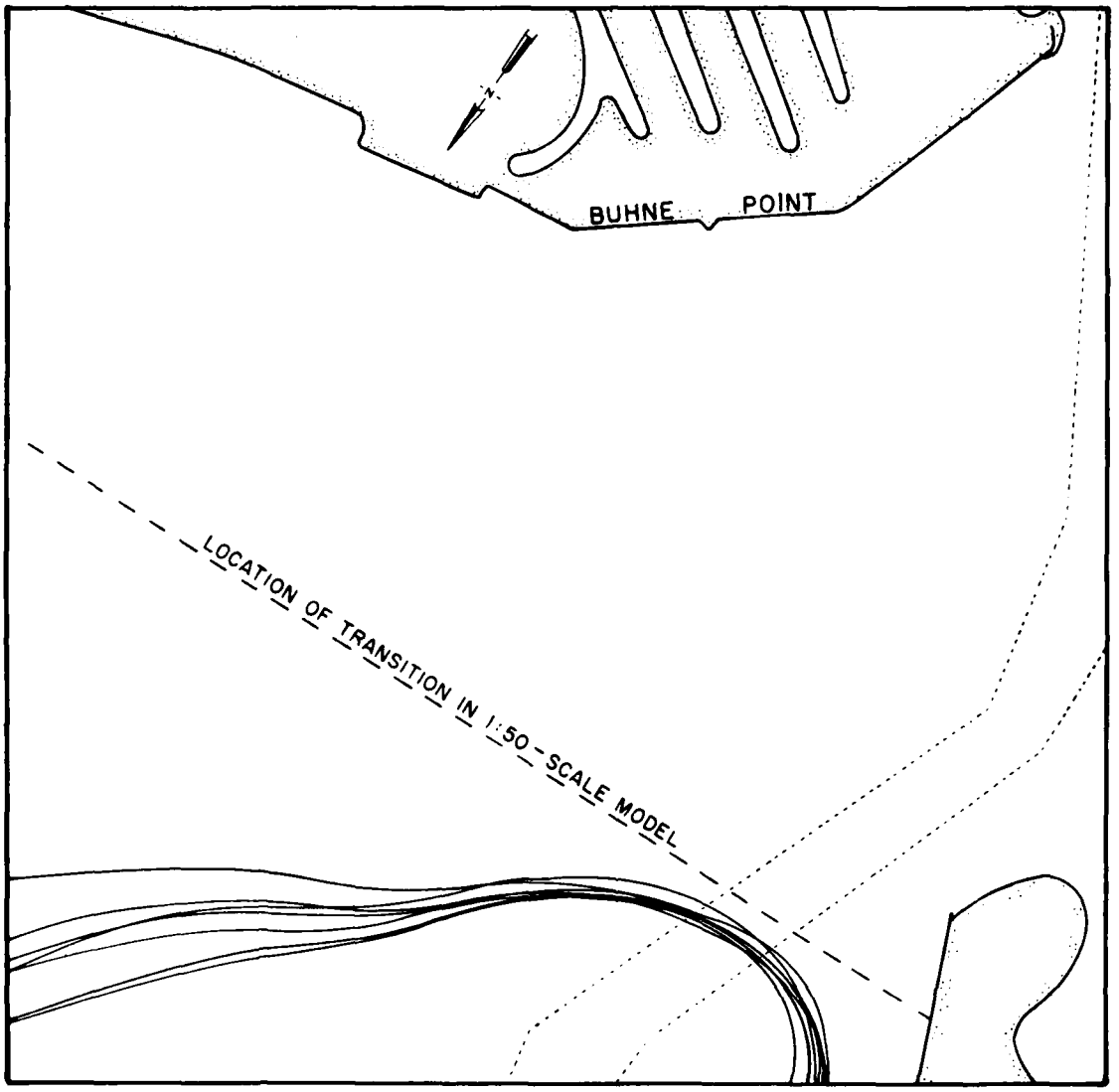


Plate 26. Wave fronts for test waves approaching Buhne Point from north; +6.7 ft swl

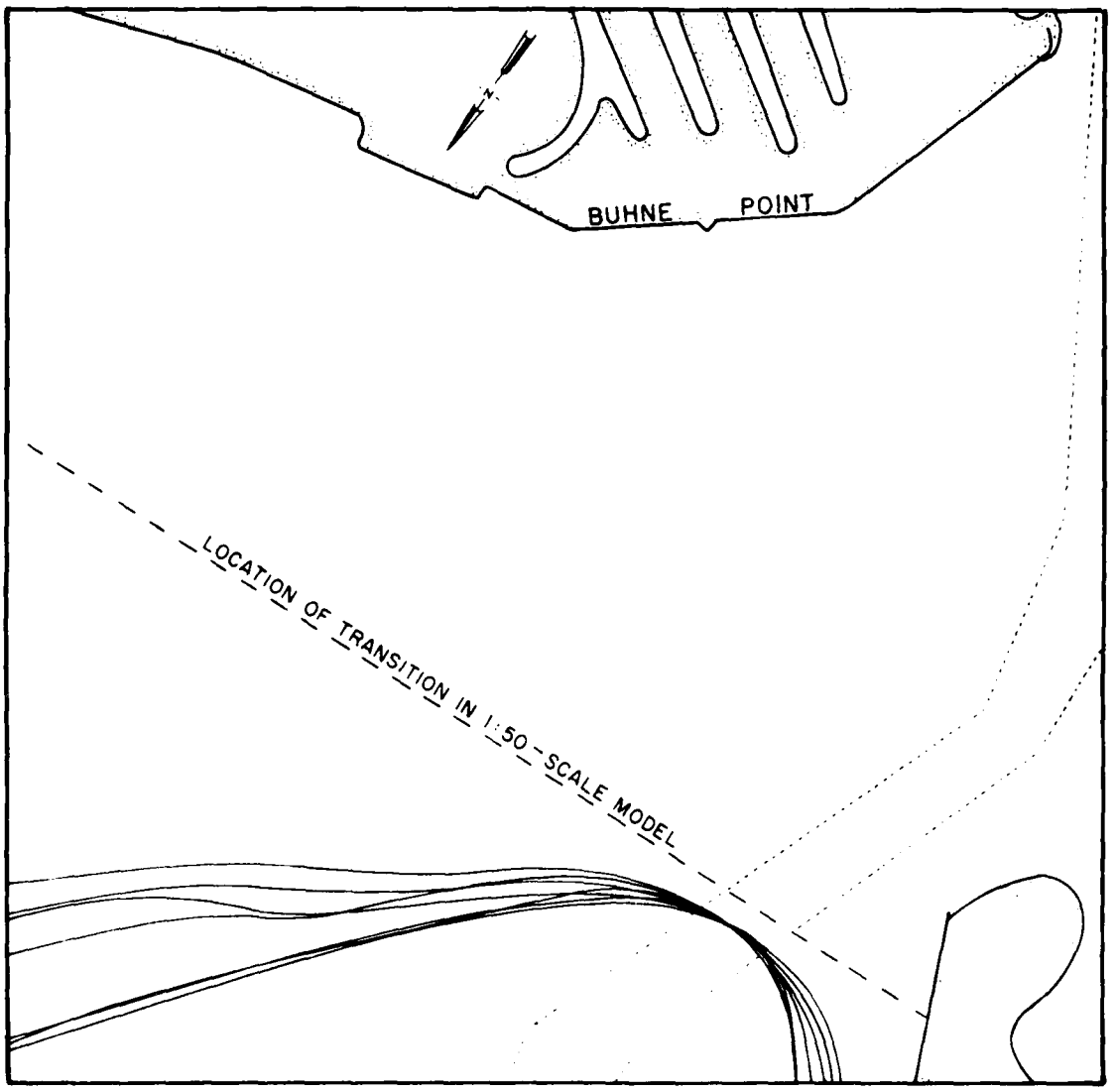


Plate 27. Wave fronts for test waves approaching Buhne Point from north; +9.5 ft swl

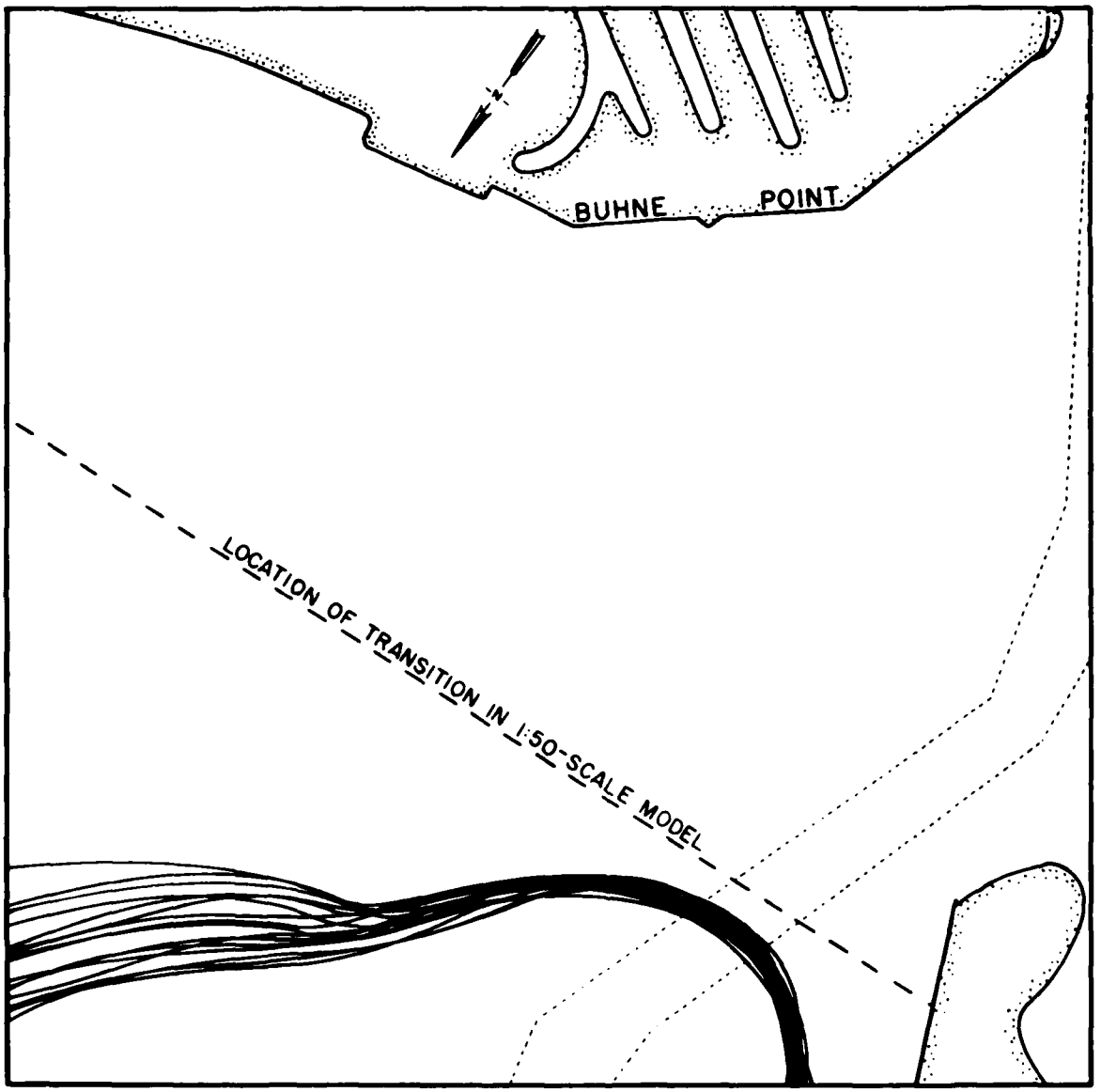


Plate 28. Wave fronts for test waves approaching Buhne Point from northwest; 0.0-ft swl

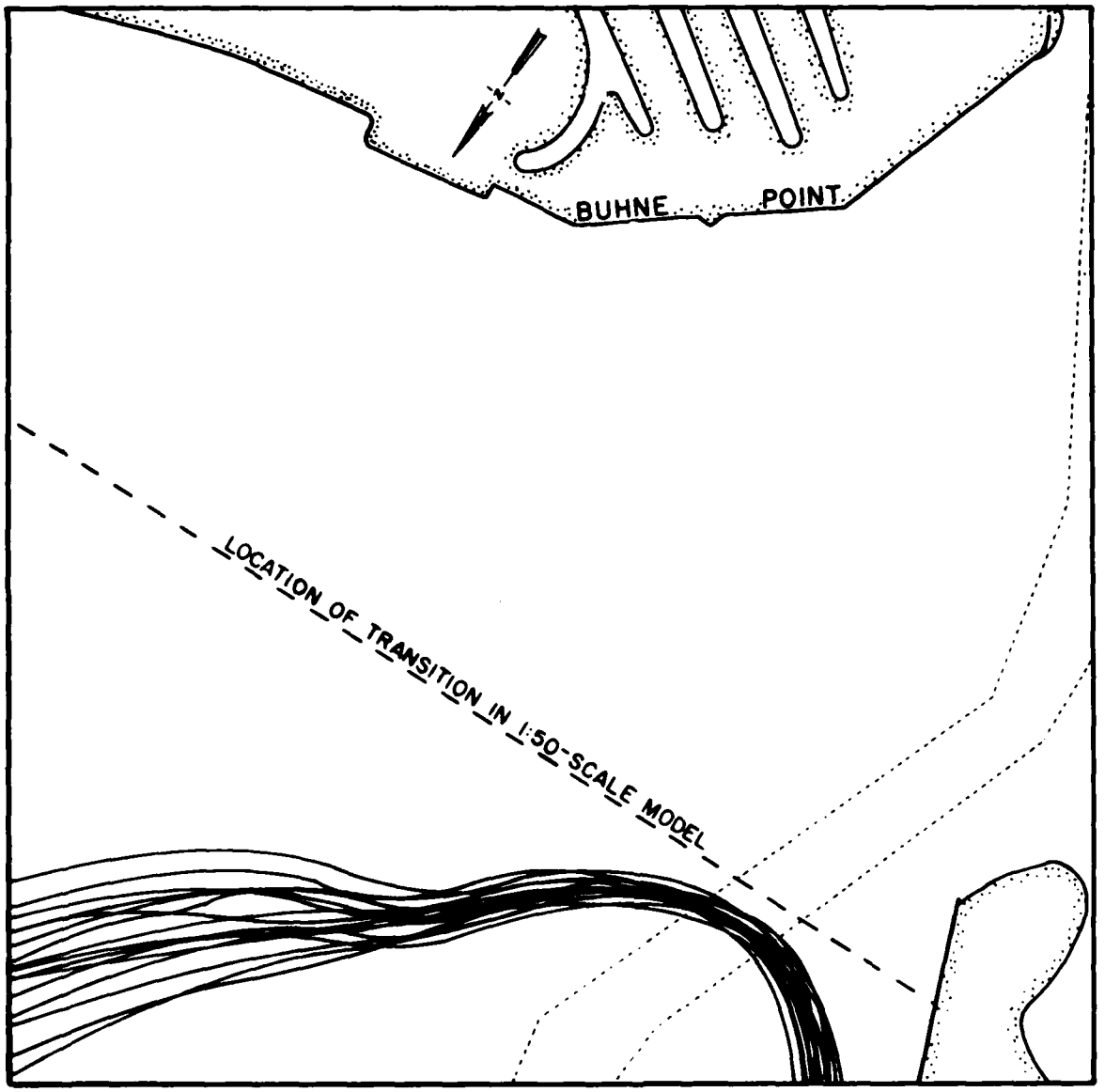


Plate 29. Wave fronts for test waves approaching Buhne Point from northwest for maximum flood; +3.2 ft swl

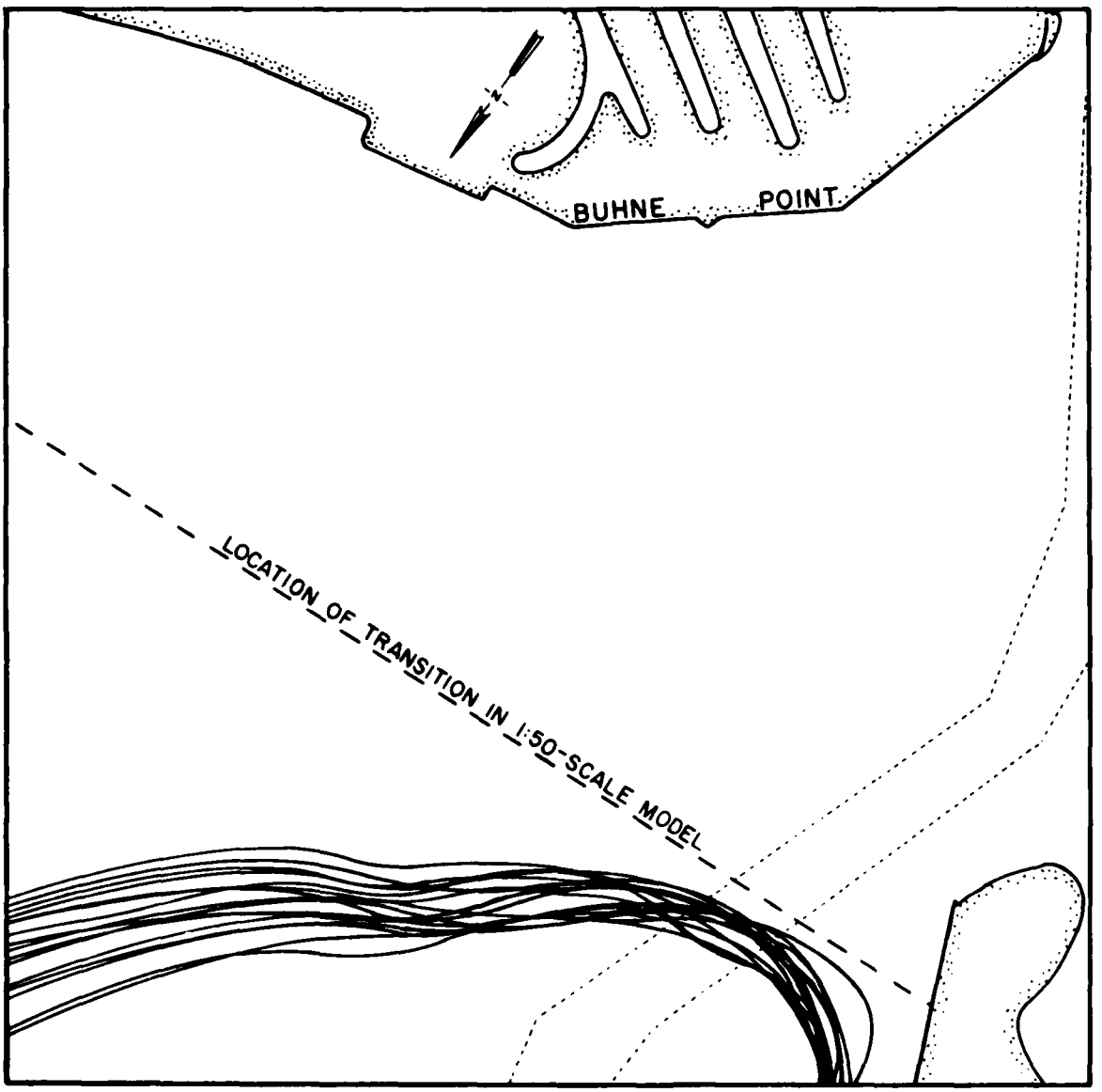


Plate 30. Wave fronts for test waves approaching Buhne Point from northwest for maximum ebb; +3.7 ft swl

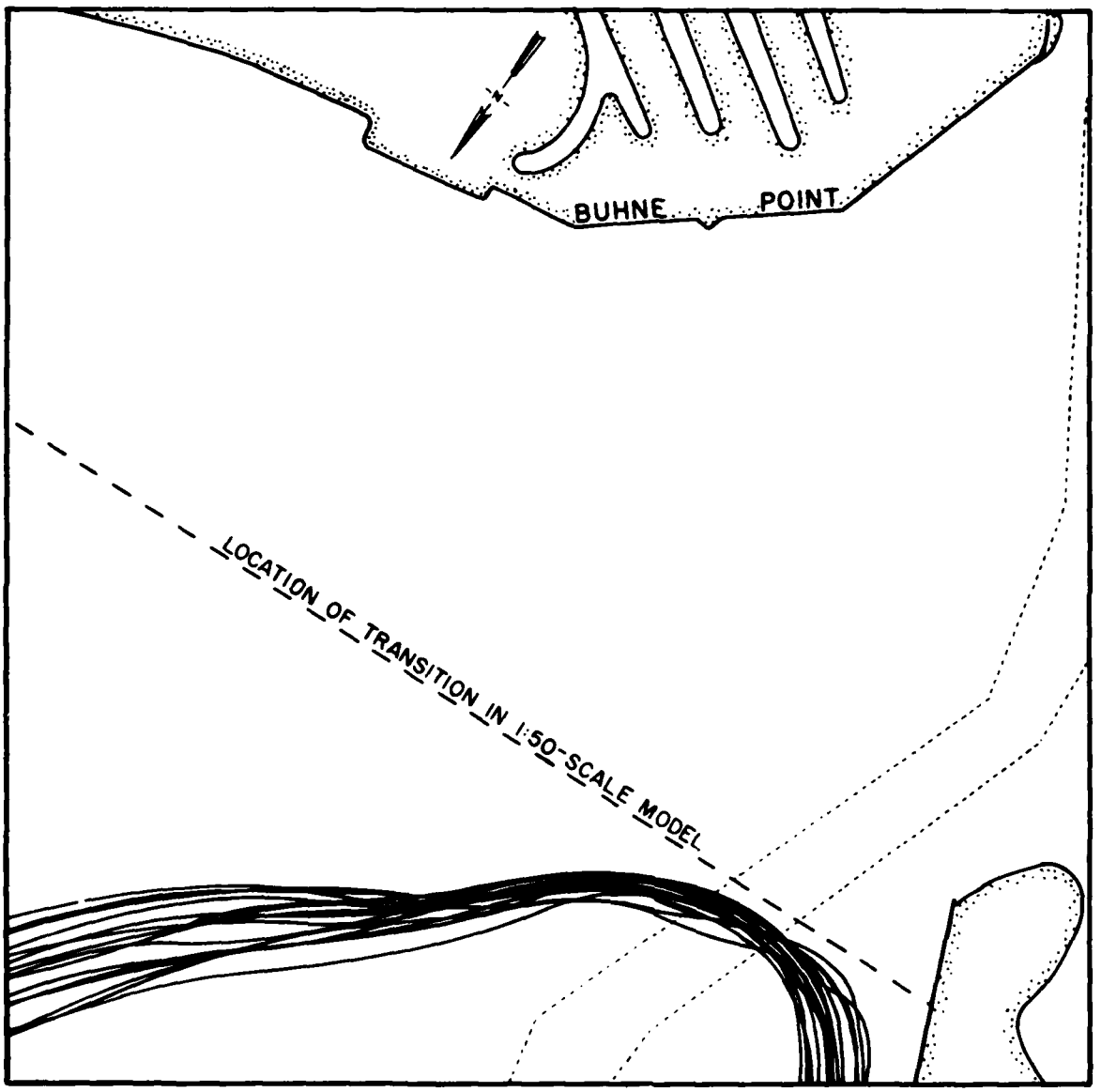


Plate 31. Wave fronts for test waves approaching Buhne Point from northwest; +6.7 ft swl

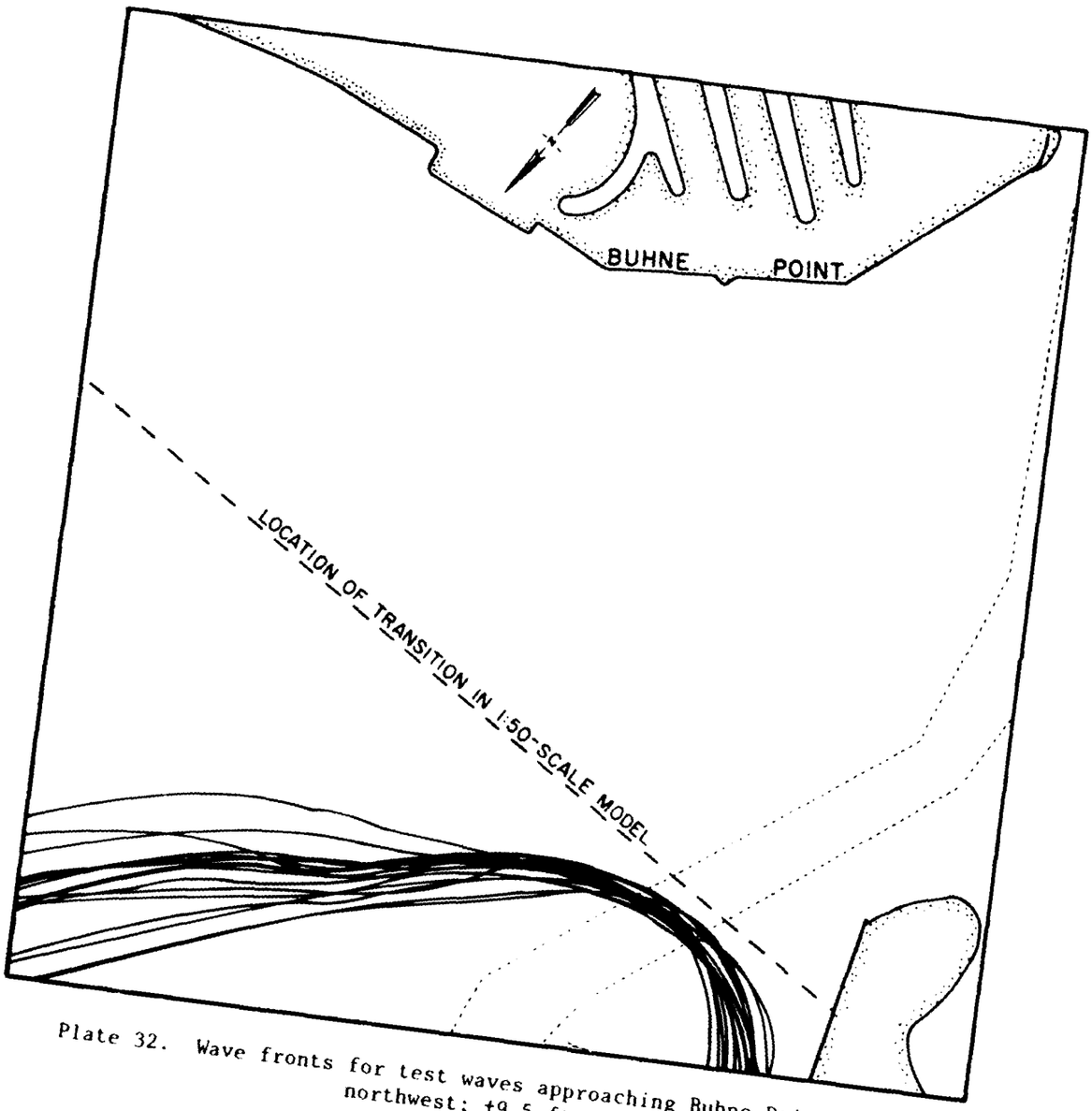


Plate 32. Wave fronts for test waves approaching Buhne Point from northwest; +9.5 ft swl

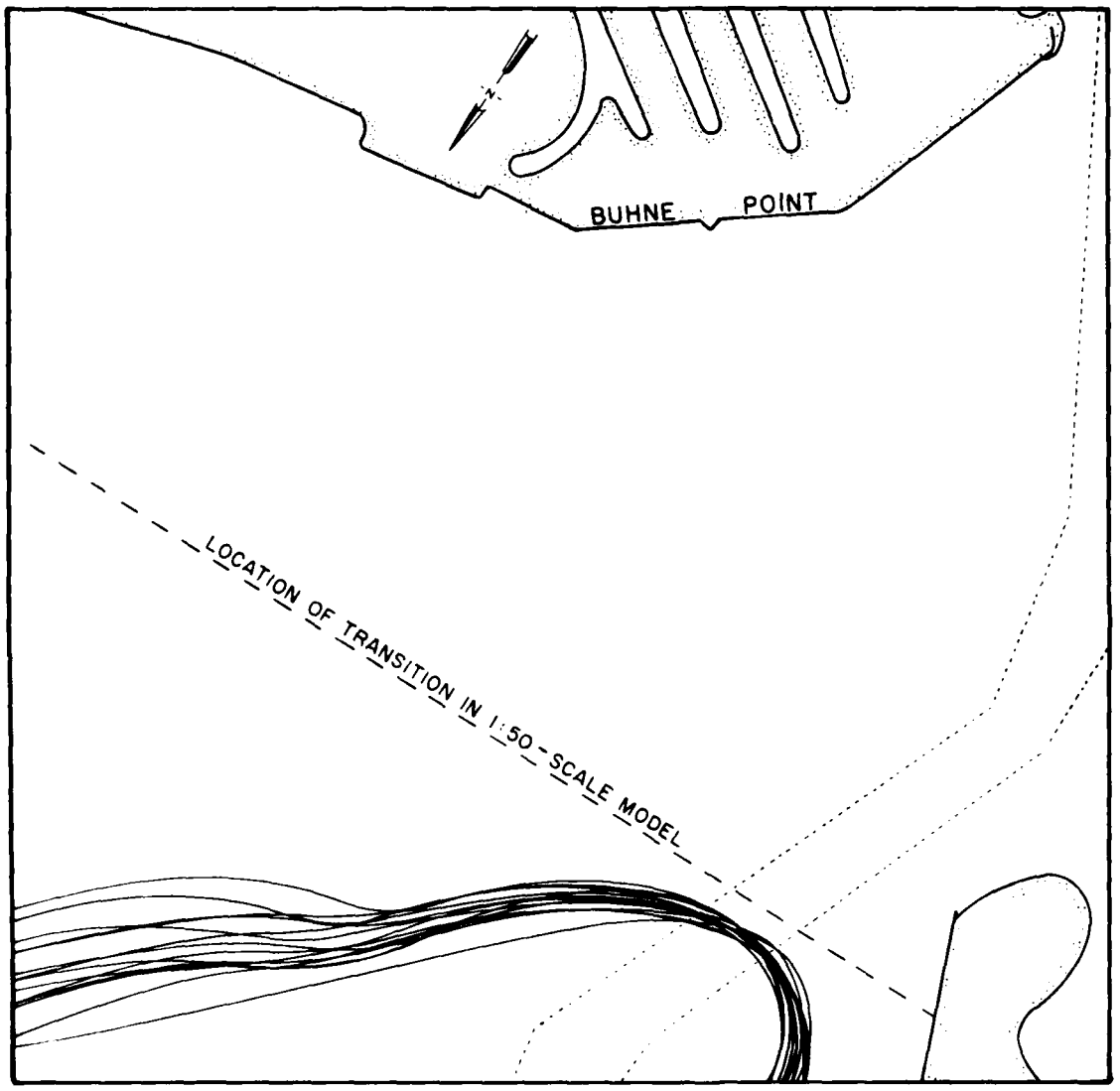


Plate 33. Wave fronts for test waves approaching Buhne Point from west; 0.0-ft swl

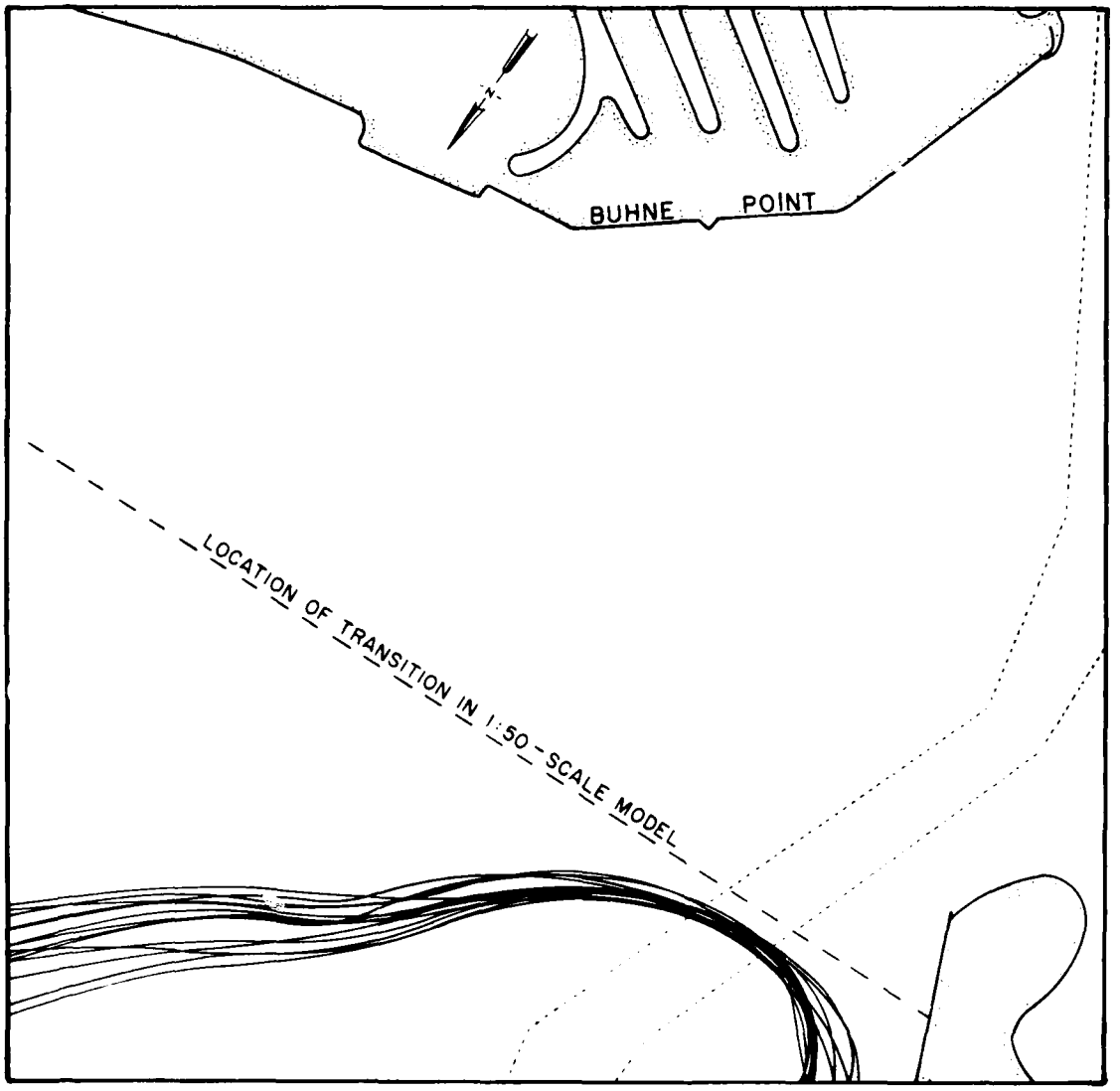


Plate 34. Wave fronts for test waves approaching Buhne Point from west for maximum flood; +3.2 ft swl

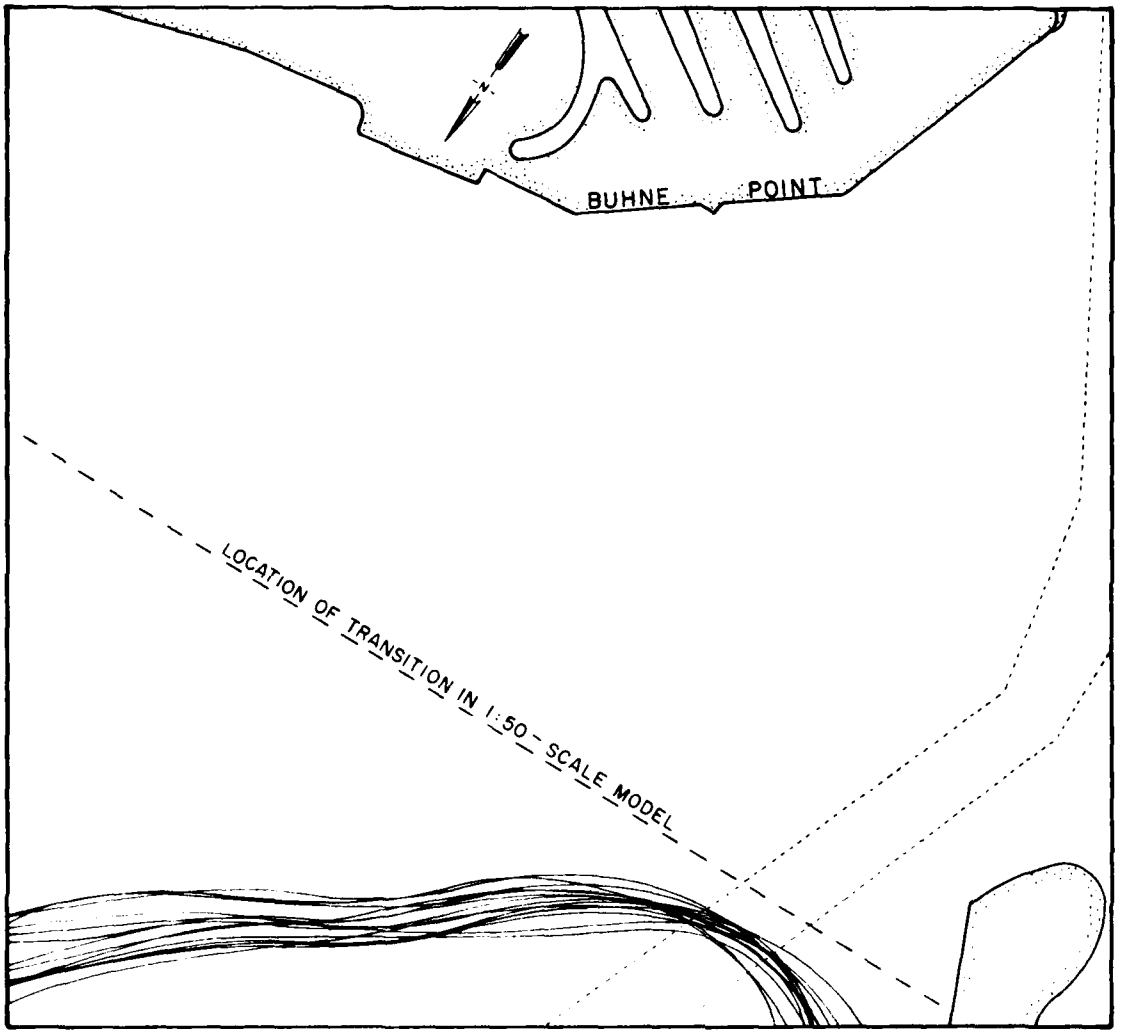


Plate 35. Wave fronts for test waves approaching Buhne Point from west for maximum ebb; +3.7 ft swl

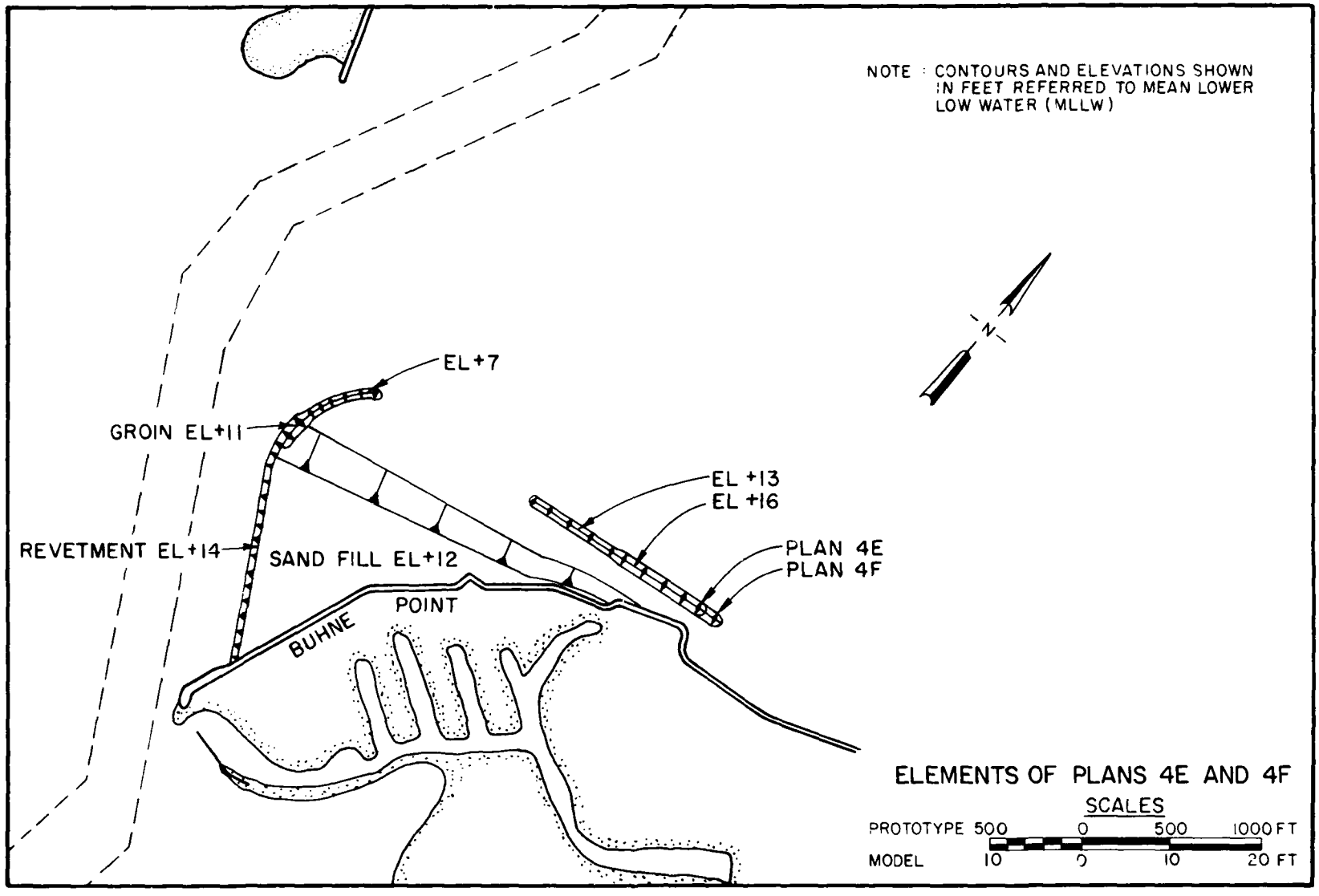
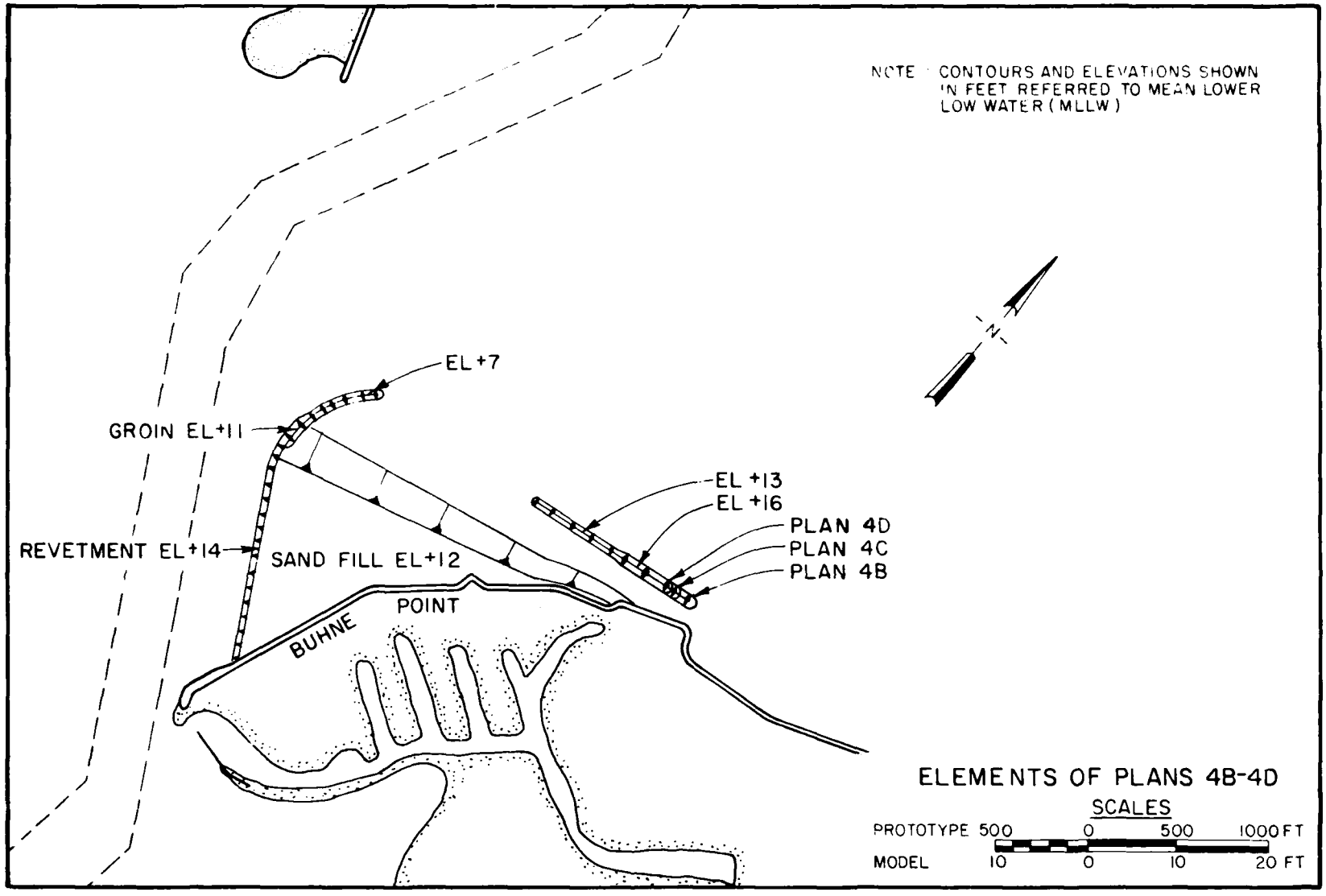

NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
EL +7
GROIN EL +11
EL +13
EL +16
REVETMENT EL +14
SAND FILL EL +12
PLAN 4E
PLAN 4F
BUHNE
POINT
ELEMENTS OF PLANS 4E AND 4F
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

PLATE 49

PLATE 48


NOTE: CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
EL +7
GROIN EL +11
EL +13
EL +16
PLAN 4D
PLAN 4C
PLAN 4B
REVETMENT EL +14
SAND FILL EL +12
BUHNE
POINT
ELEMENTS OF PLANS 4B-4D
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

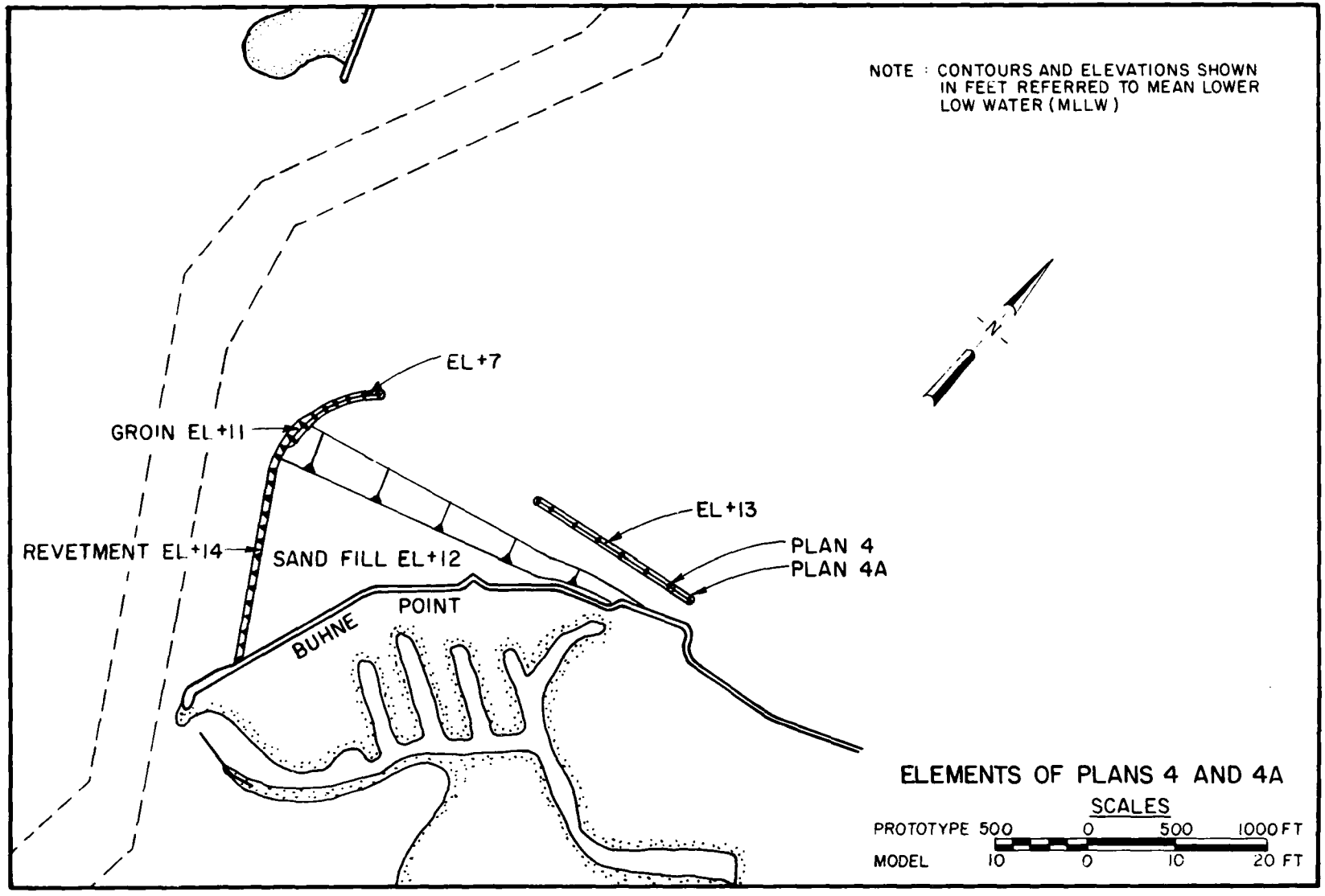
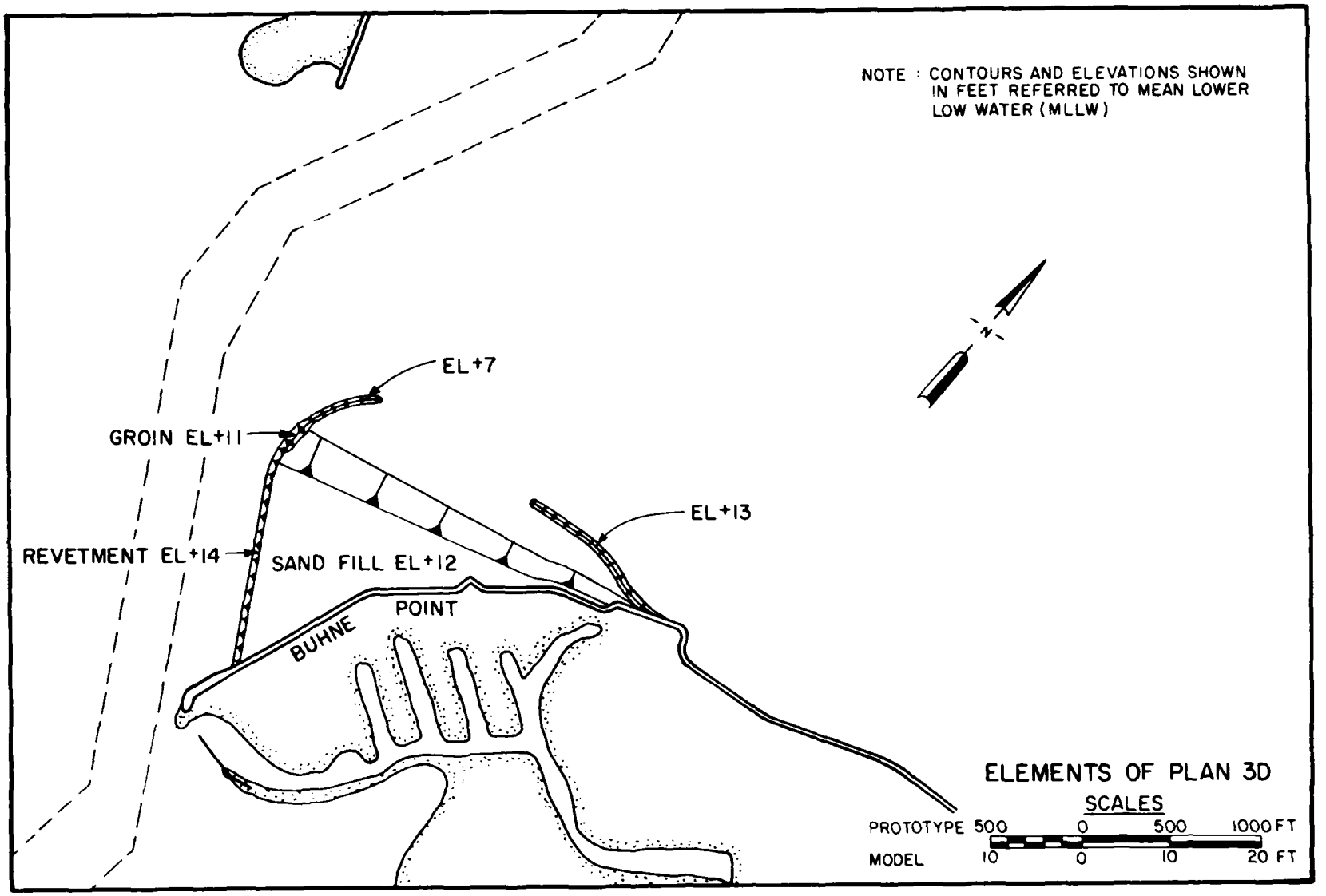

NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
EL +7
GROIN EL +11
EL +13
PLAN 4
PLAN 4A
REVETMENT EL +14
SAND FILL EL +12
BUHNE
POINT
ELEMENTS OF PLANS 4 AND 4A
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

PLATE 47

PLATE 46


NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
EL+7
GROIN EL+11
EL+13
REVETMENT EL+14
SAND FILL EL+12
BUHNE
POINT
ELEMENTS OF PLAN 3D
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

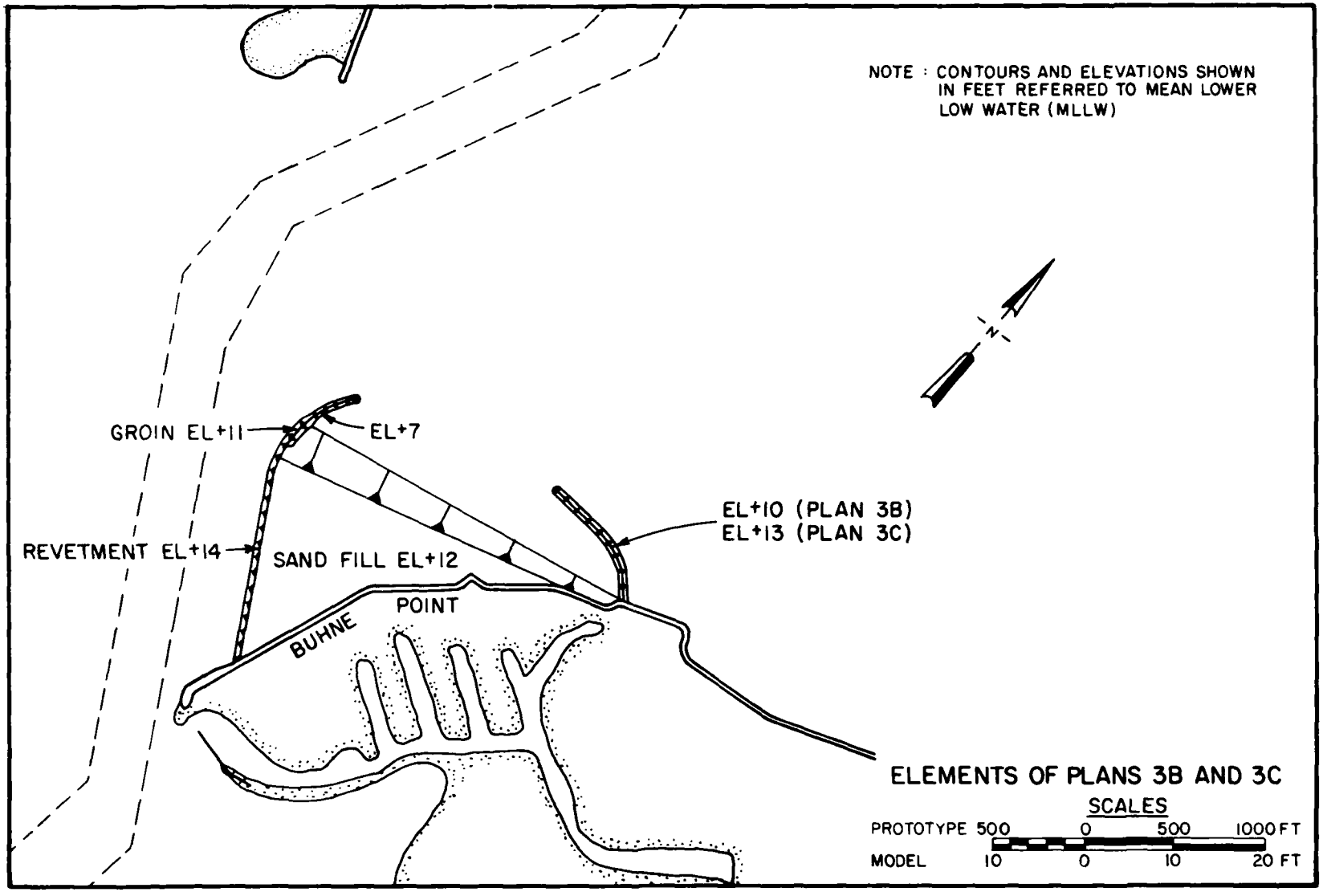
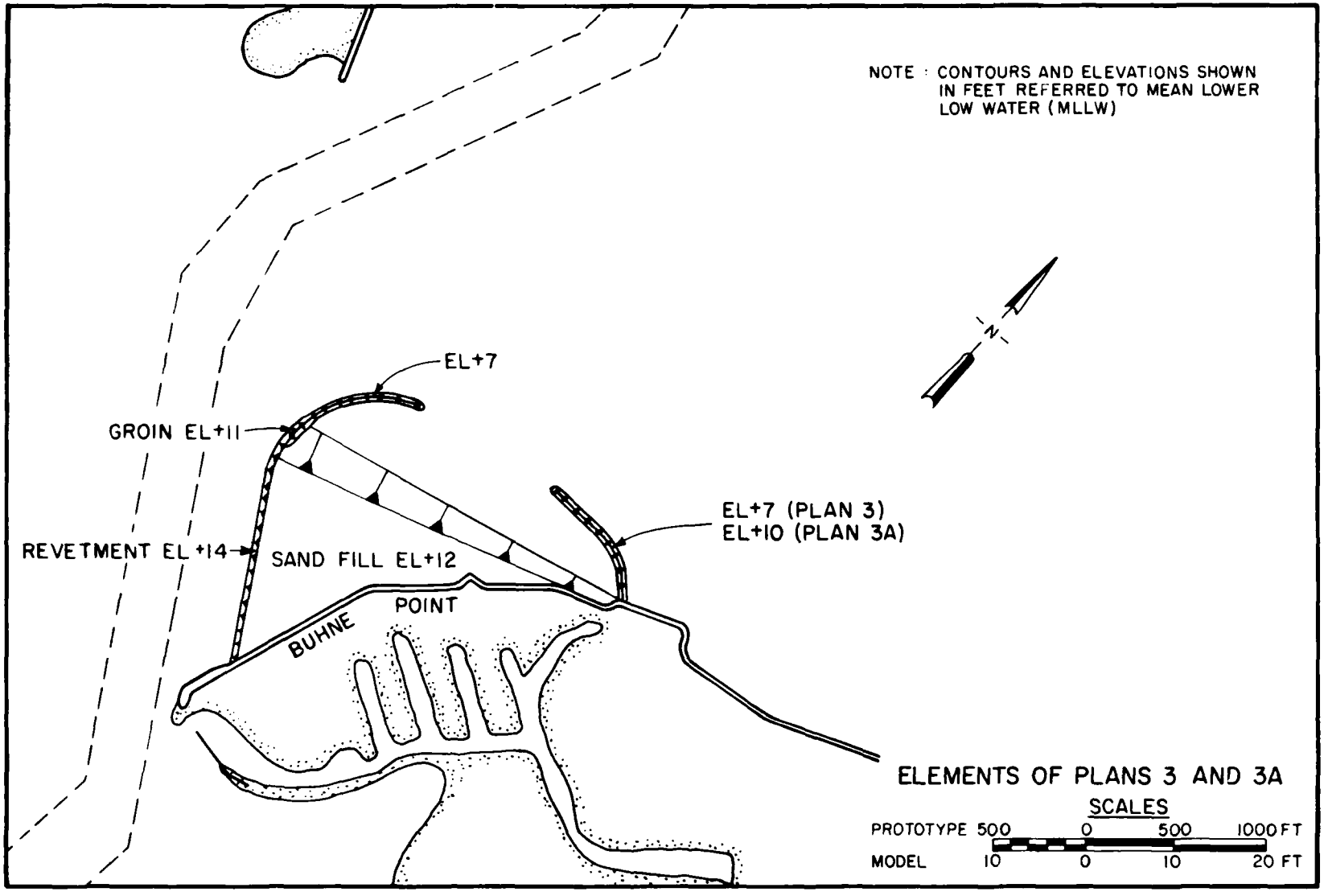

NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
GROIN EL+11
EL+7
EL+10 (PLAN 3B)
EL+13 (PLAN 3C)
REVETMENT EL+14
SAND FILL EL+12
BUHNE
POINT
ELEMENTS OF PLANS 3B AND 3C
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

PLATE 45

PLATE 44


NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
EL+7
GROIN EL+11
EL+7 (PLAN 3)
EL+10 (PLAN 3A)
REVETMENT EL+14
SAND FILL EL+12
POINT
BUHNE
ELEMENTS OF PLANS 3 AND 3A
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

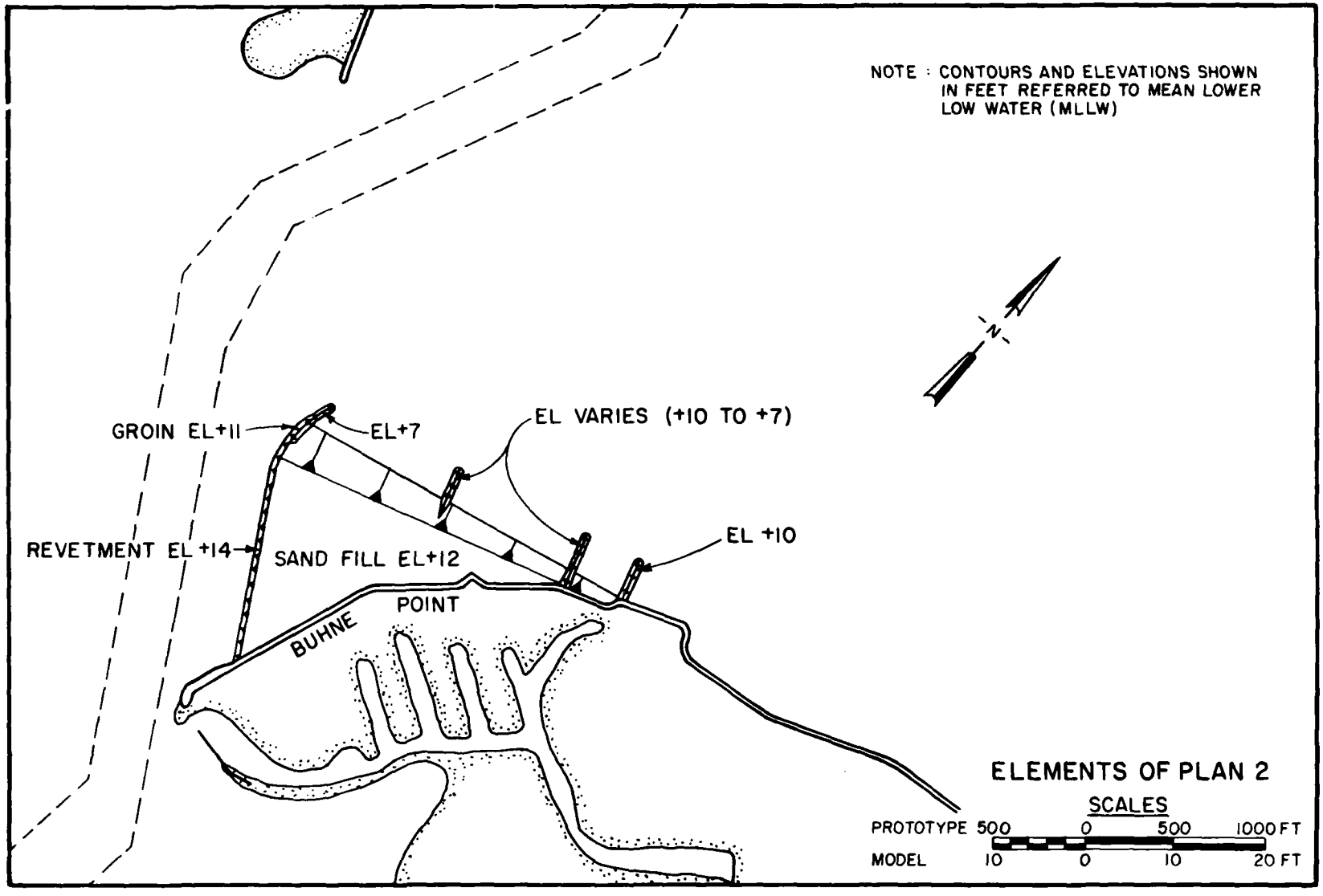
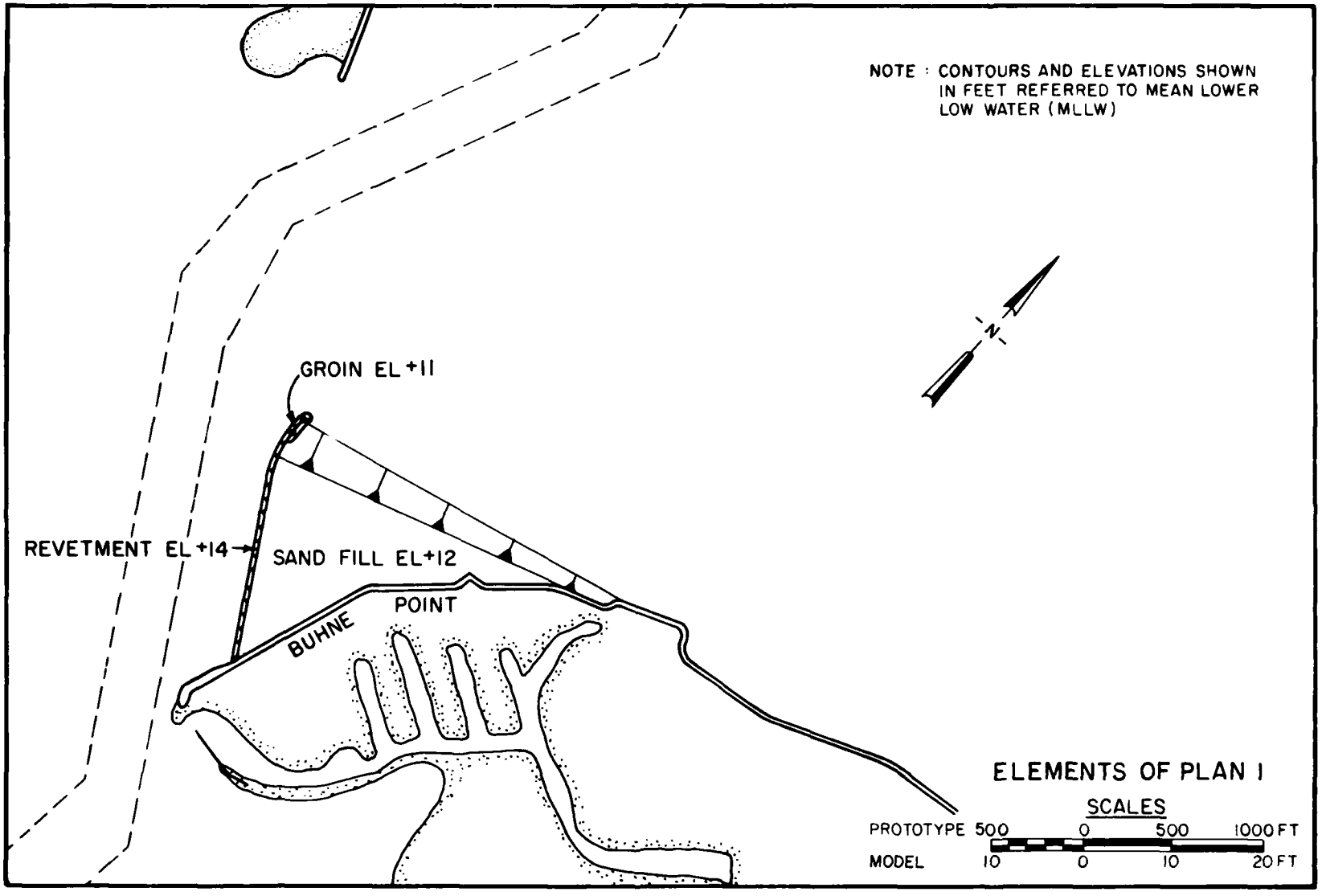

NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
GROIN EL+11
EL+7
EL VARIES (+10 TO +7)
EL +10
REVETMENT EL +14
SAND FILL EL+12
BUHNE
POINT
ELEMENTS OF PLAN 2
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

PLATE 43

PLATE 42


NOTE : CONTOURS AND ELEVATIONS SHOWN IN FEET REFERRED TO MEAN LOWER LOW WATER (MLLW)
N
GROIN EL +11
REVETMENT EL +14
SAND FILL EL +12
BUHNE
POINT
ELEMENTS OF PLAN I
SCALES
PROTOTYPE 500 0 500 1000 FT
MODEL 10 0 10 20 FT

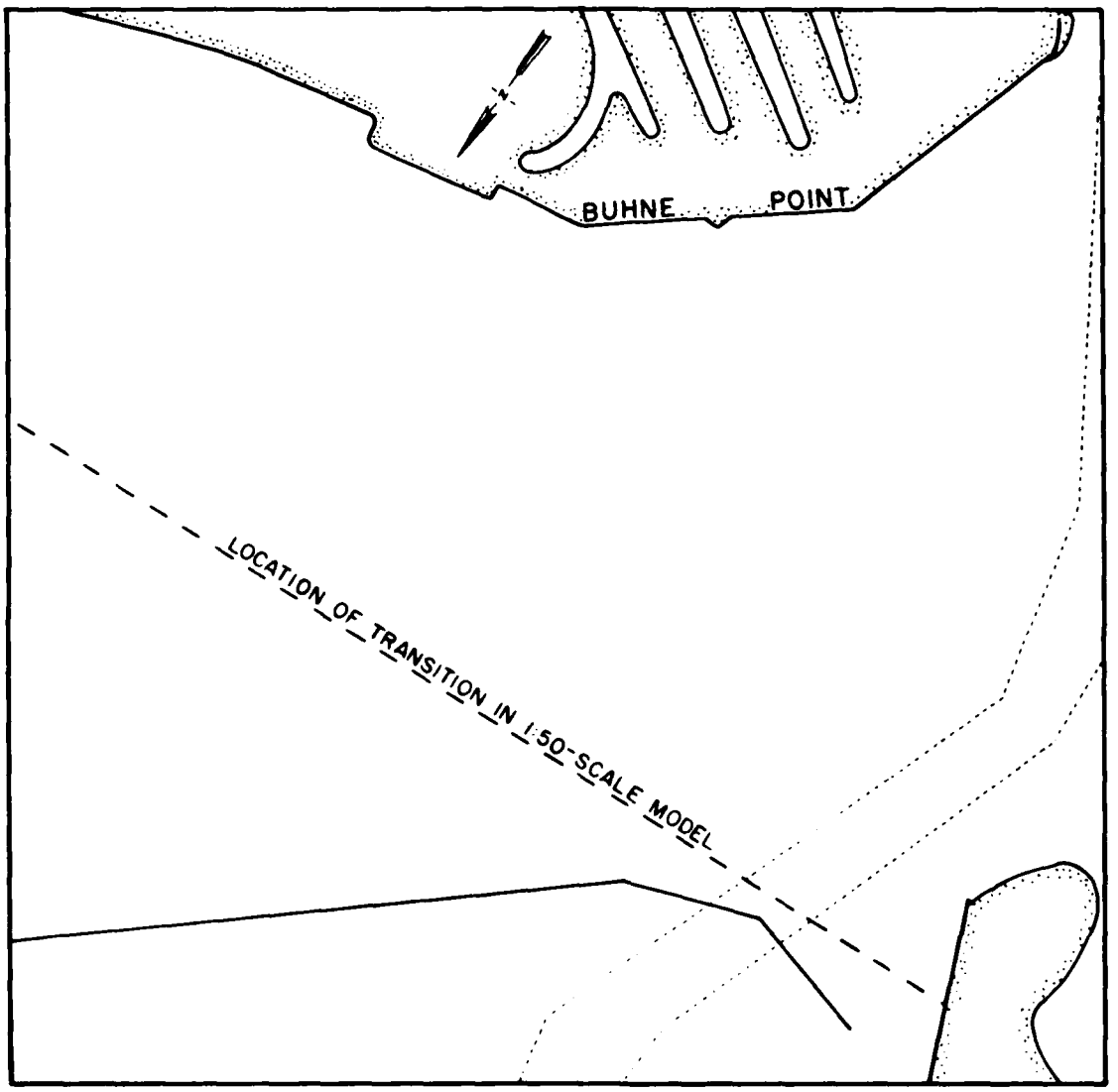
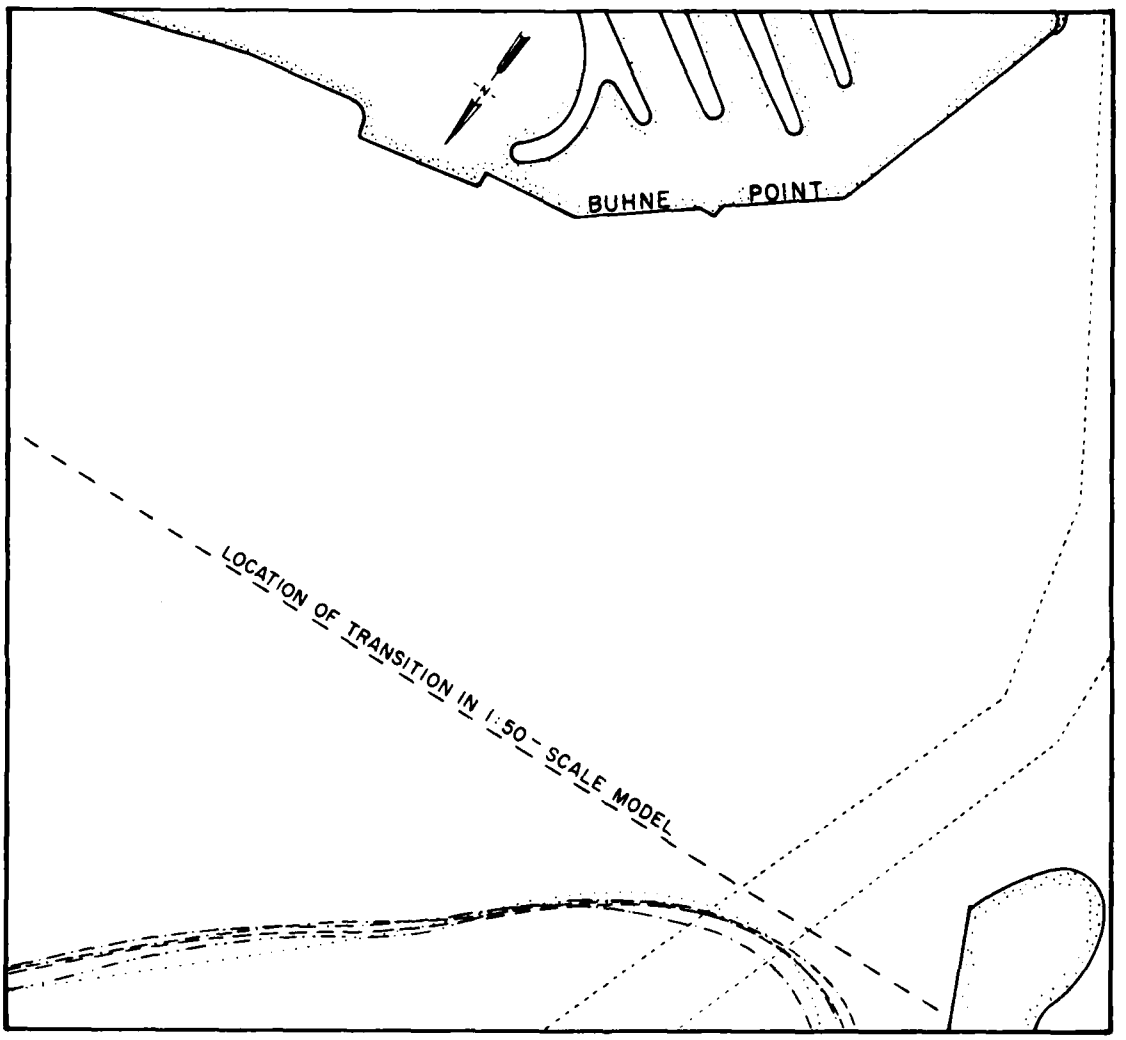


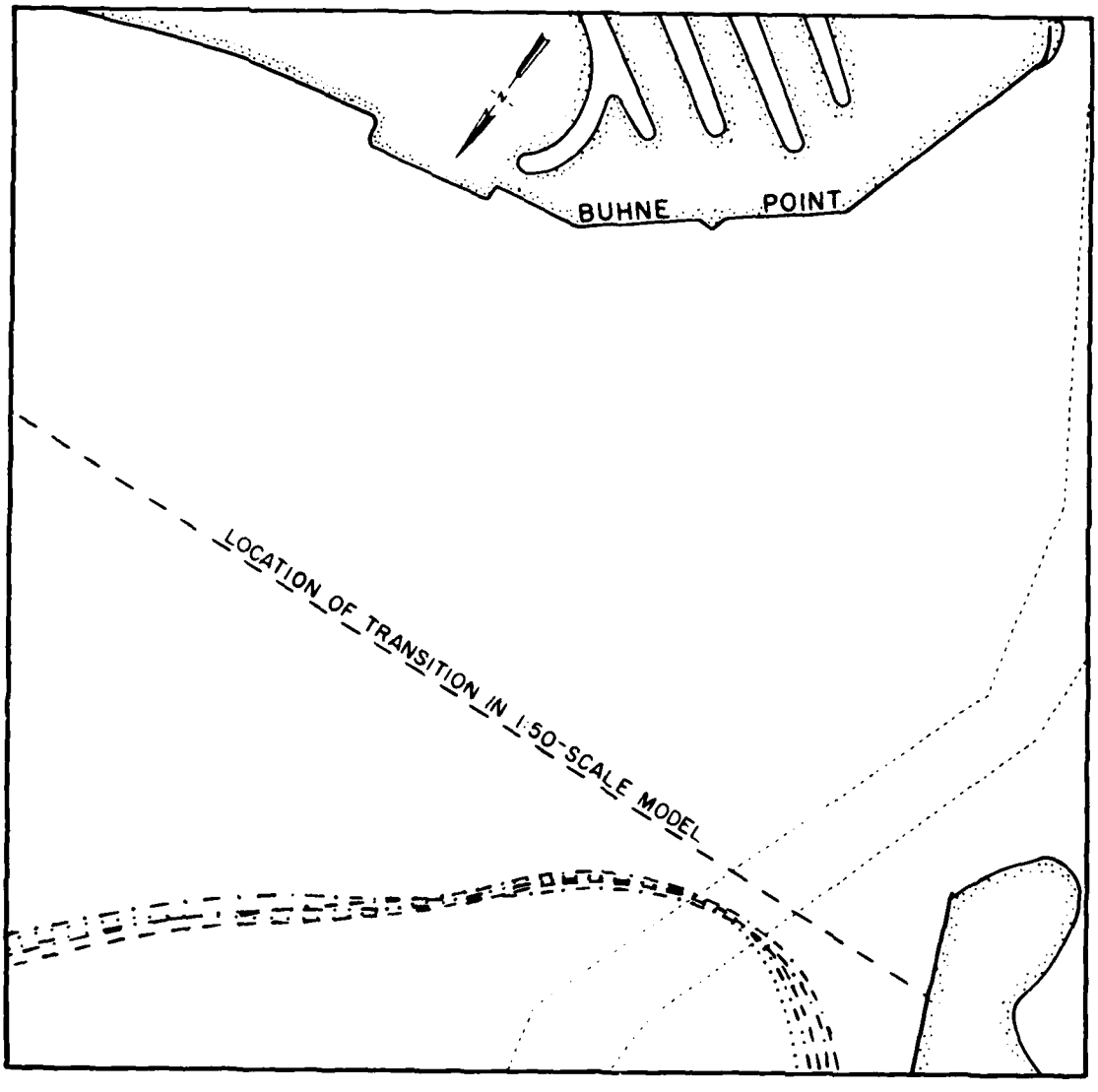
Plate 41. Wave generator angle (wave front) selected for use in the 1:50-scale model



LEGEND

SWL 0.0 FT
SWL +3.2 FT
SWL +3.7 FT
SWL +6.7 FT
SWL +9.5 FT

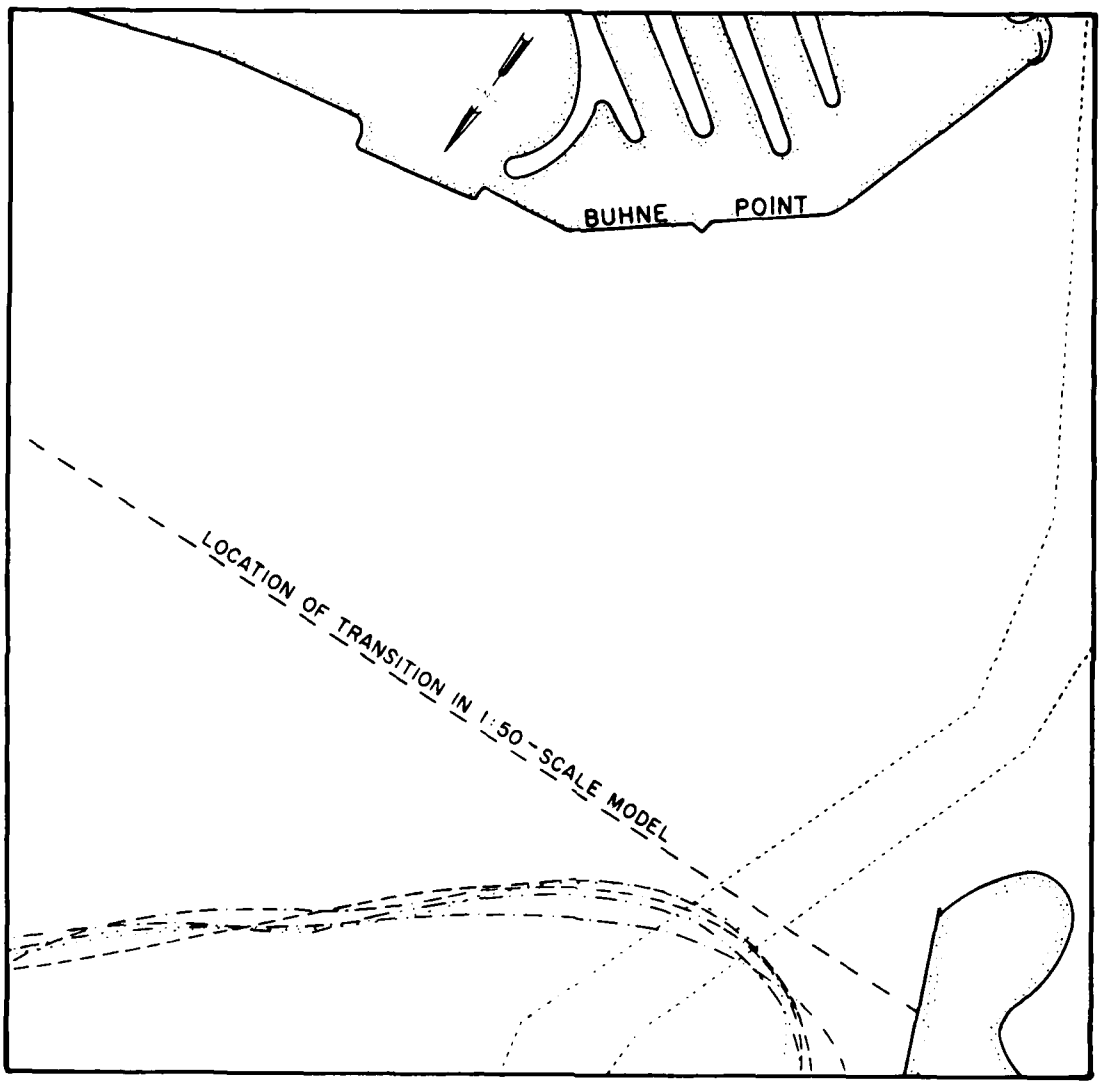
Plate 40. Averages of wave fronts approaching Buhne Point from west for various swl's



LEGEND

- SWL 0.0 FT
- SWL +3.2 FT
- SWL +3.7 FT
- SWL +6.7 FT
- SWL +9.5 FT

Plate 39. Averages of wave fronts approaching Buhne Point from northwest for various swl's



LEGEND

SWL 0.0 FT
SWL +3.2 FT
SWL +3.7 FT
SWL +6.7 FT
SWL +9.5 FT

Plate 38. Averages of wave fronts approaching Buhne Point from north for various swl's

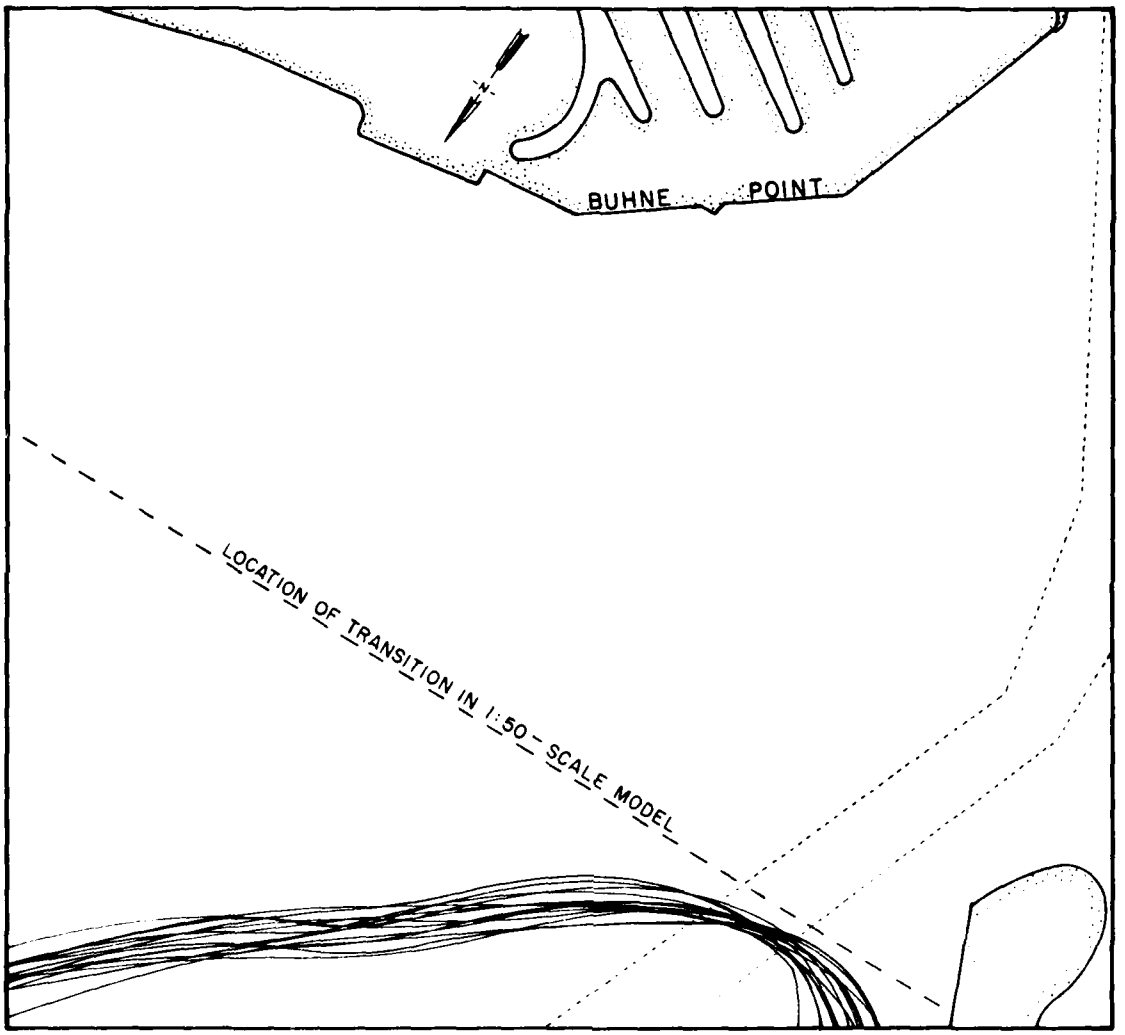


Plate 37. Wave fronts for test waves approaching Buhne Point from west; +9.5 ft swl

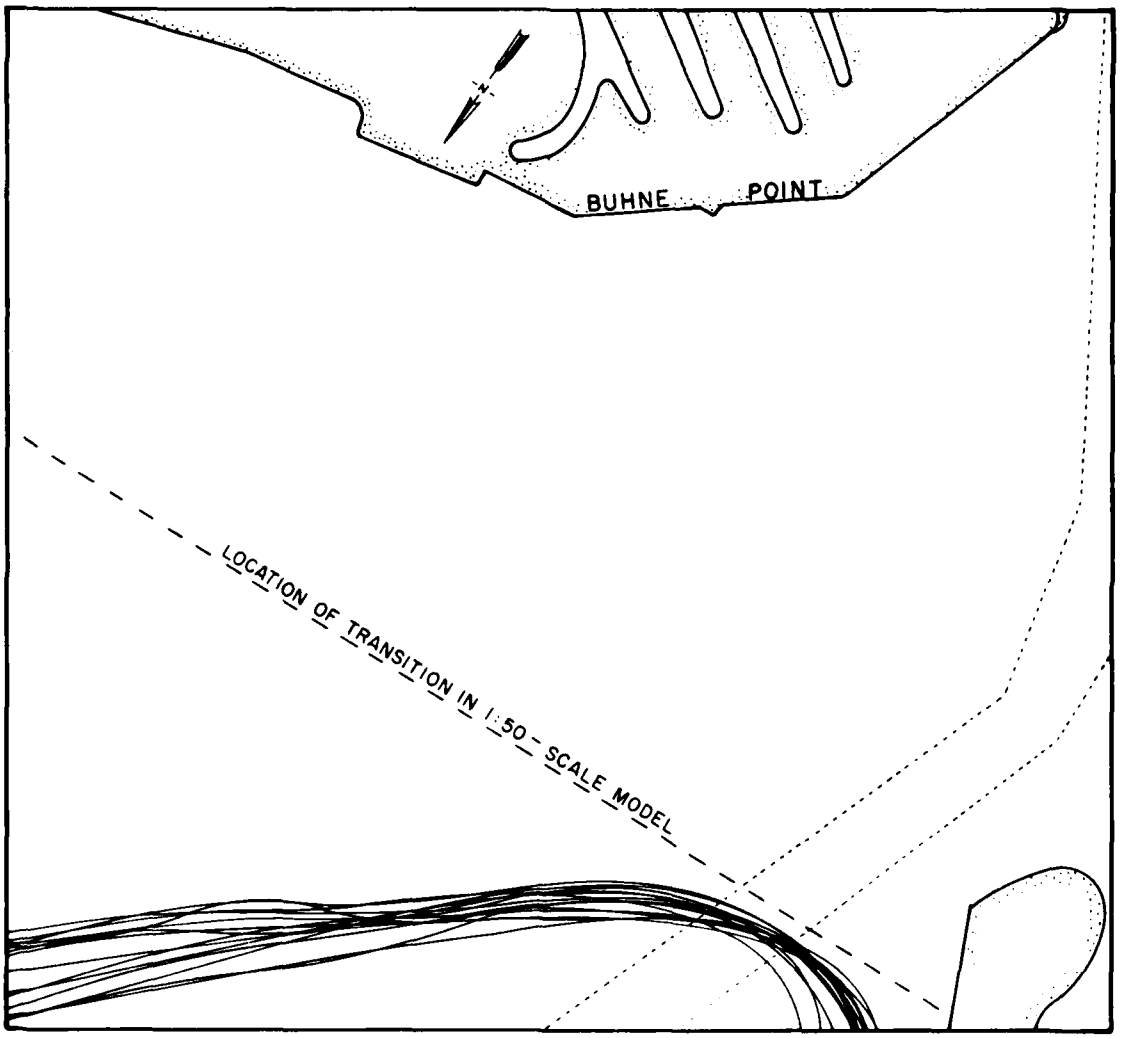
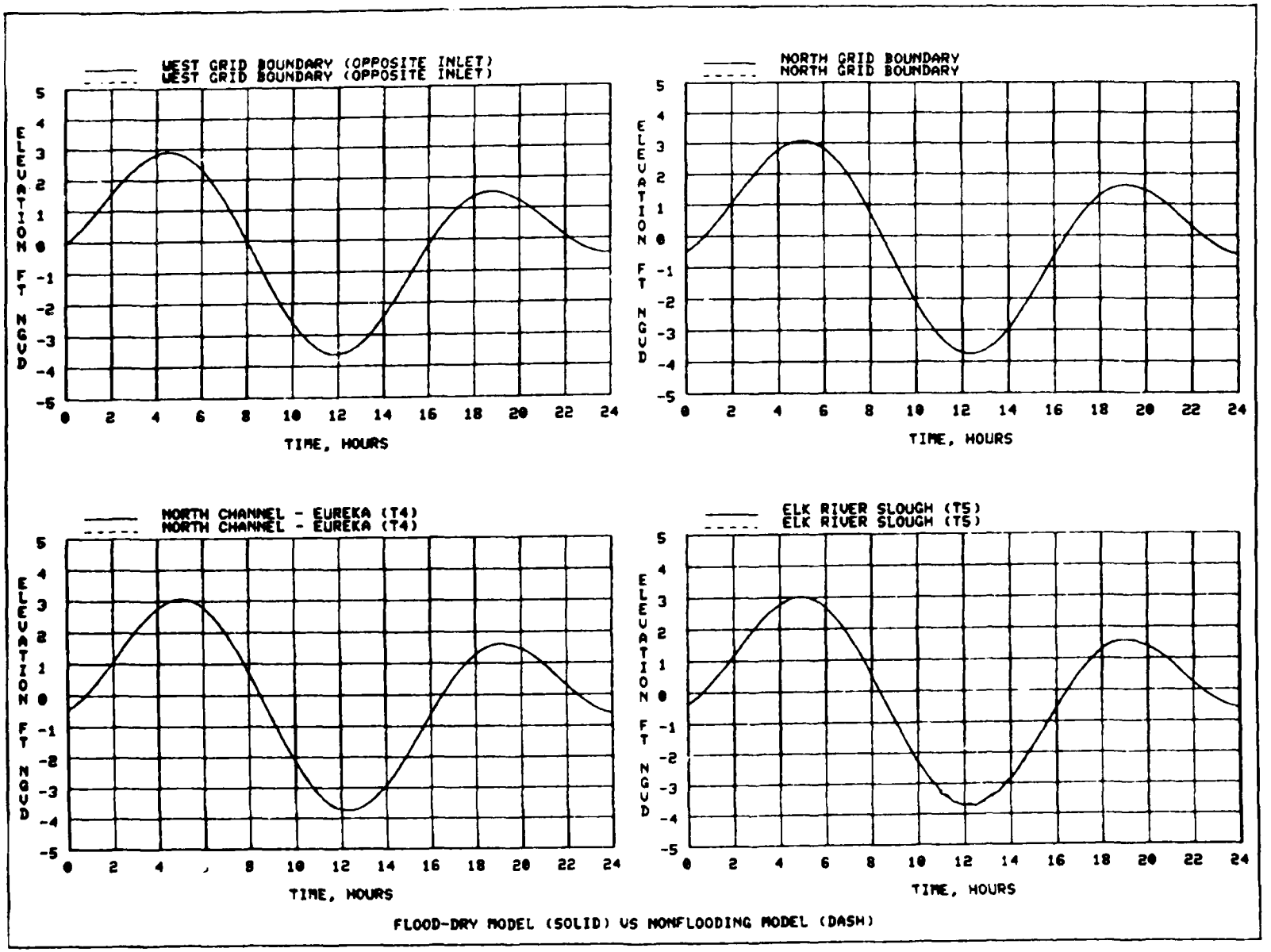
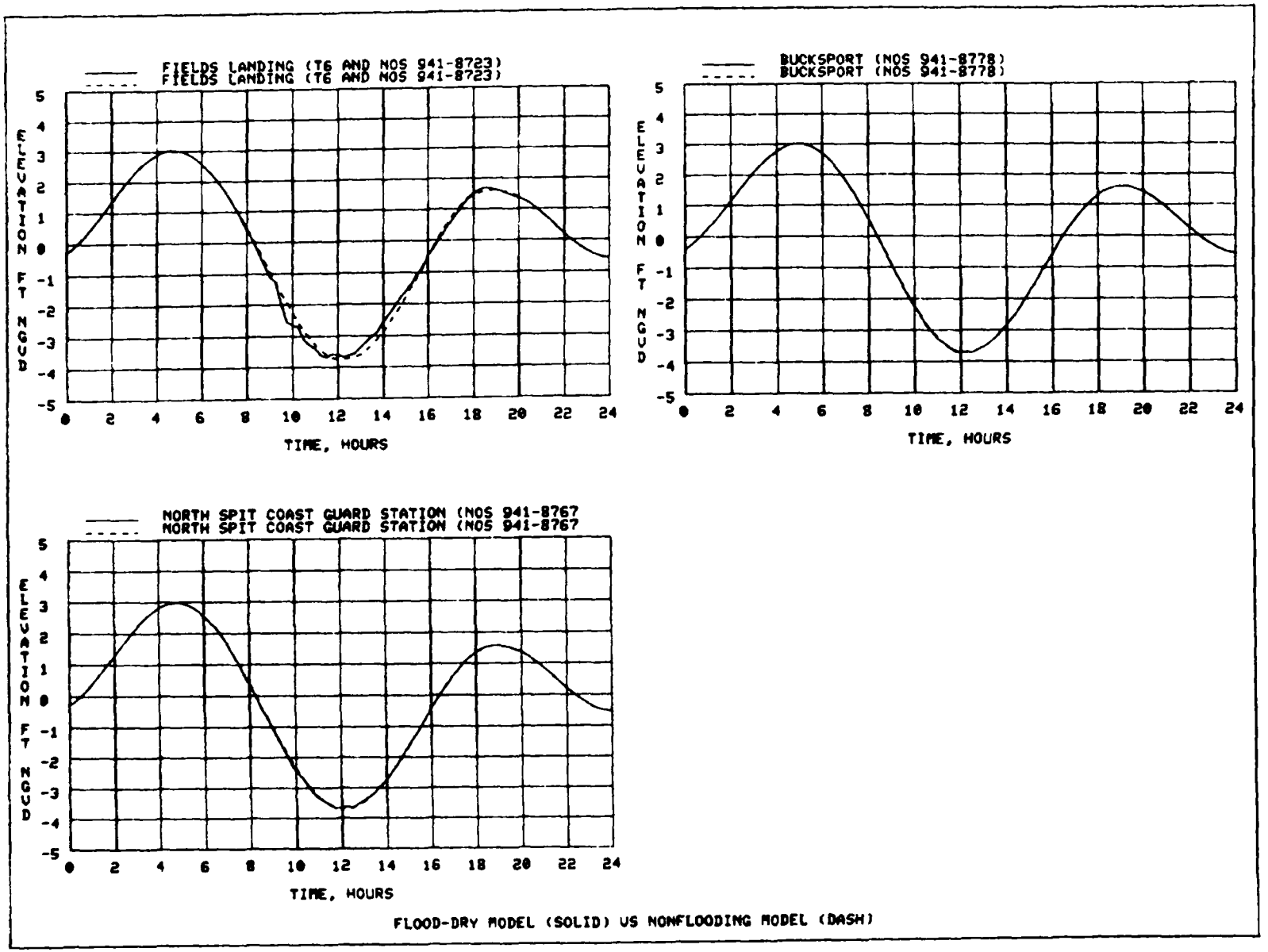


Plate 36. Wave fronts for test waves approaching Buhne Point from west; +6.7 ft swl

PLATE 50


WEST GRID BOUNDARY (OPPOSITE INLET)
WEST GRID BOUNDARY (OPPOSITE INLET)
NORTH GRID BOUNDARY
NORTH GRID BOUNDARY
NORTH CHANNEL - EUREKA (T4)
NORTH CHANNEL - EUREKA (T4)
ELK RIVER SLOUGH (T5)
ELK RIVER SLOUGH (T5)
ELEVATION FT NGVD
TIME, HOURS
FLOOD-DRY MODEL (SOLID) VS NONFLOODING MODEL (DASH)



FLOOD-DRY MODEL (SOLID) VS NONFLOODING MODEL (DASH)

PLATE 51

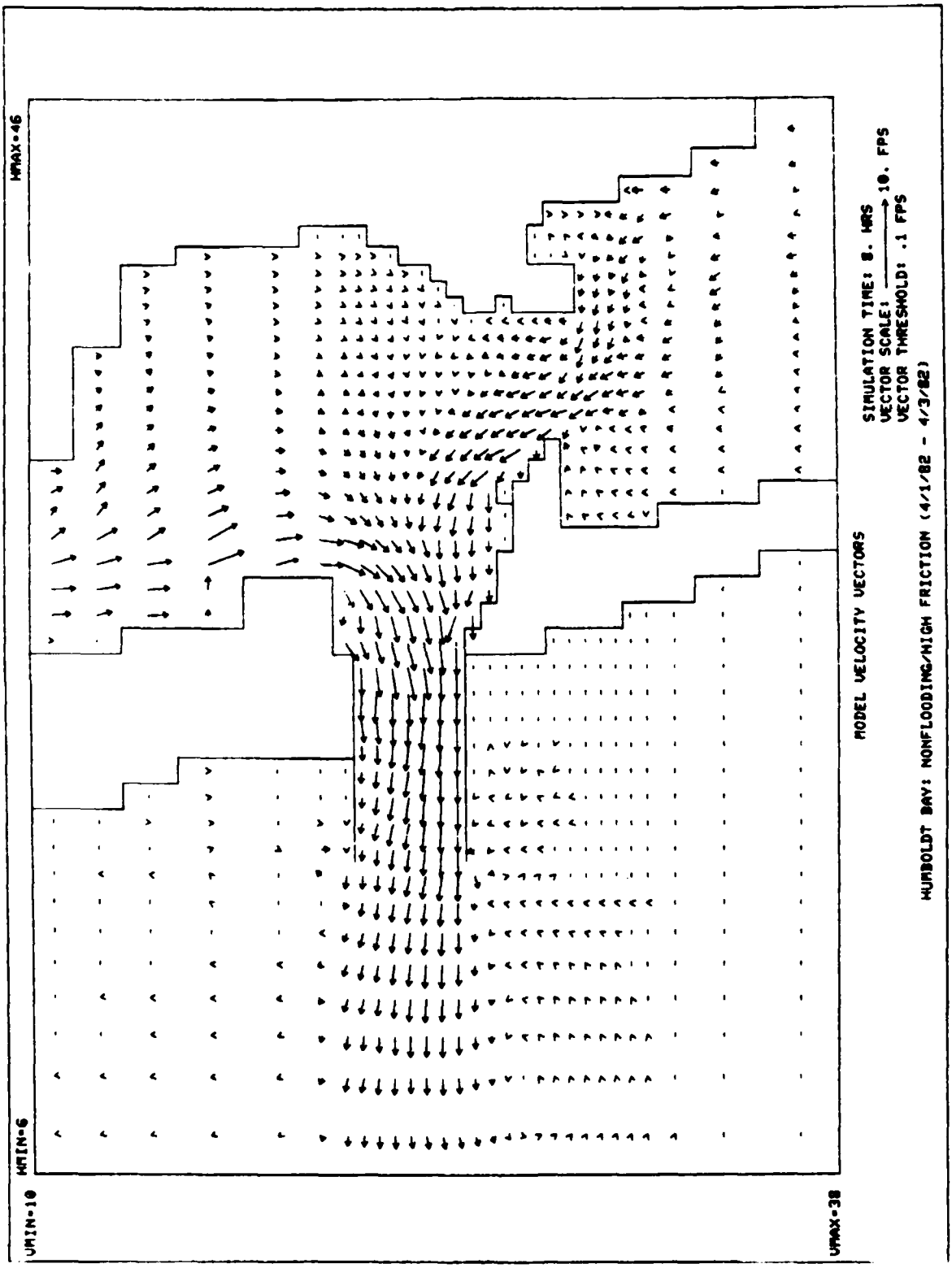

HMAX=46
HMIN=6
UMIN=10
UMAX=38
MODEL VELOCITY VECTORS
SIMULATION TIME: 8. HRS
VECTOR SCALE: ——→ 10. FPS
VECTOR THRESHOLD: .1 FPS
HUMBOLDT BAY: NONFLOODING/HIGH FRICTION (4/1/82 - 4/3/82)

PLATE 52

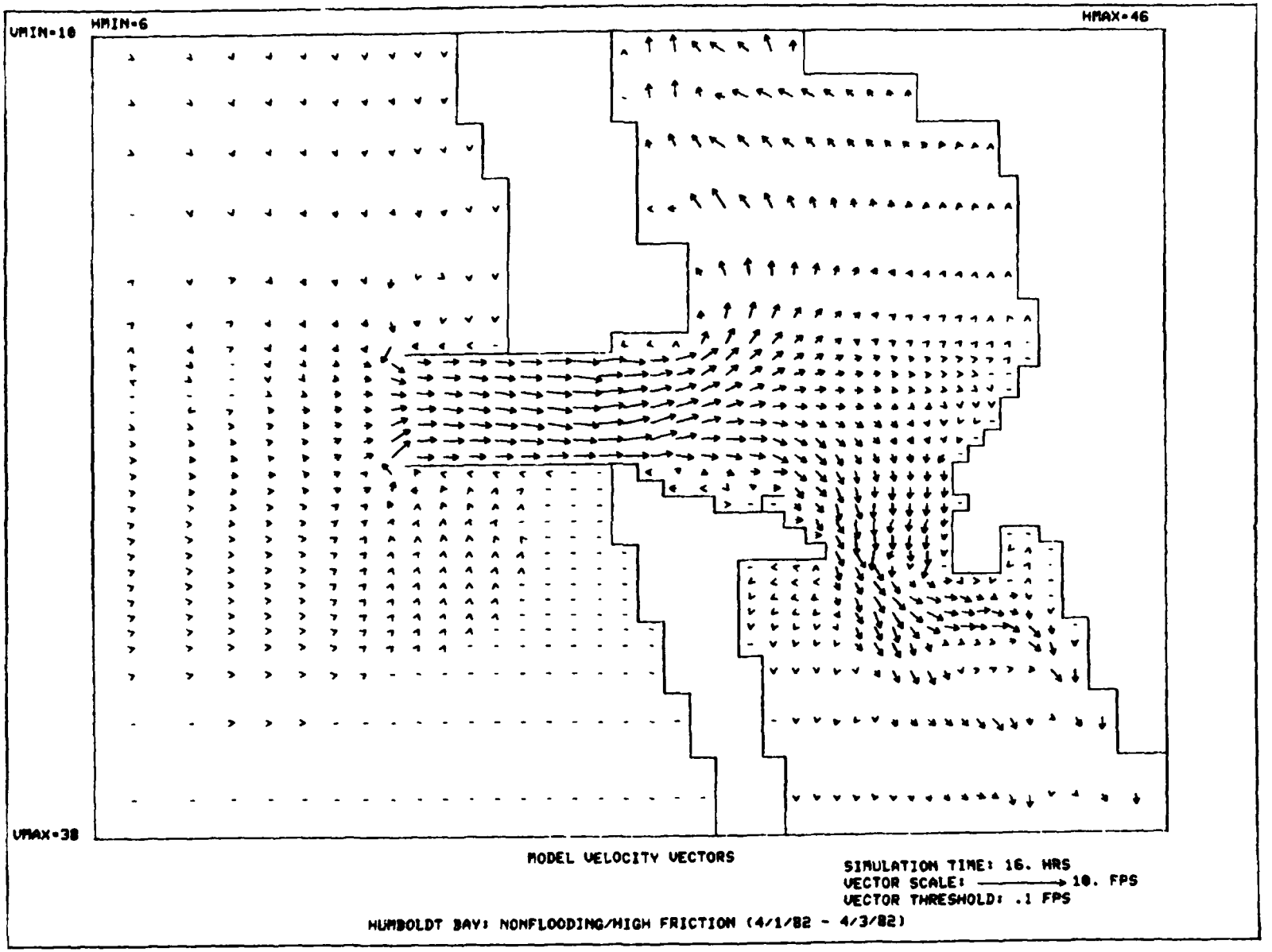

UMIN=10
HMIN=6
HMAX=46
UMAX=38
MODEL VELOCITY VECTORS
SIMULATION TIME: 16. HRS
VECTOR SCALE: ——→ 10. FPS
VECTOR THRESHOLD: .1 FPS
HUMBOLDT BAY: NONFLOODING/HIGH FRICTION (4/1/82 - 4/3/82)

PLATE 53

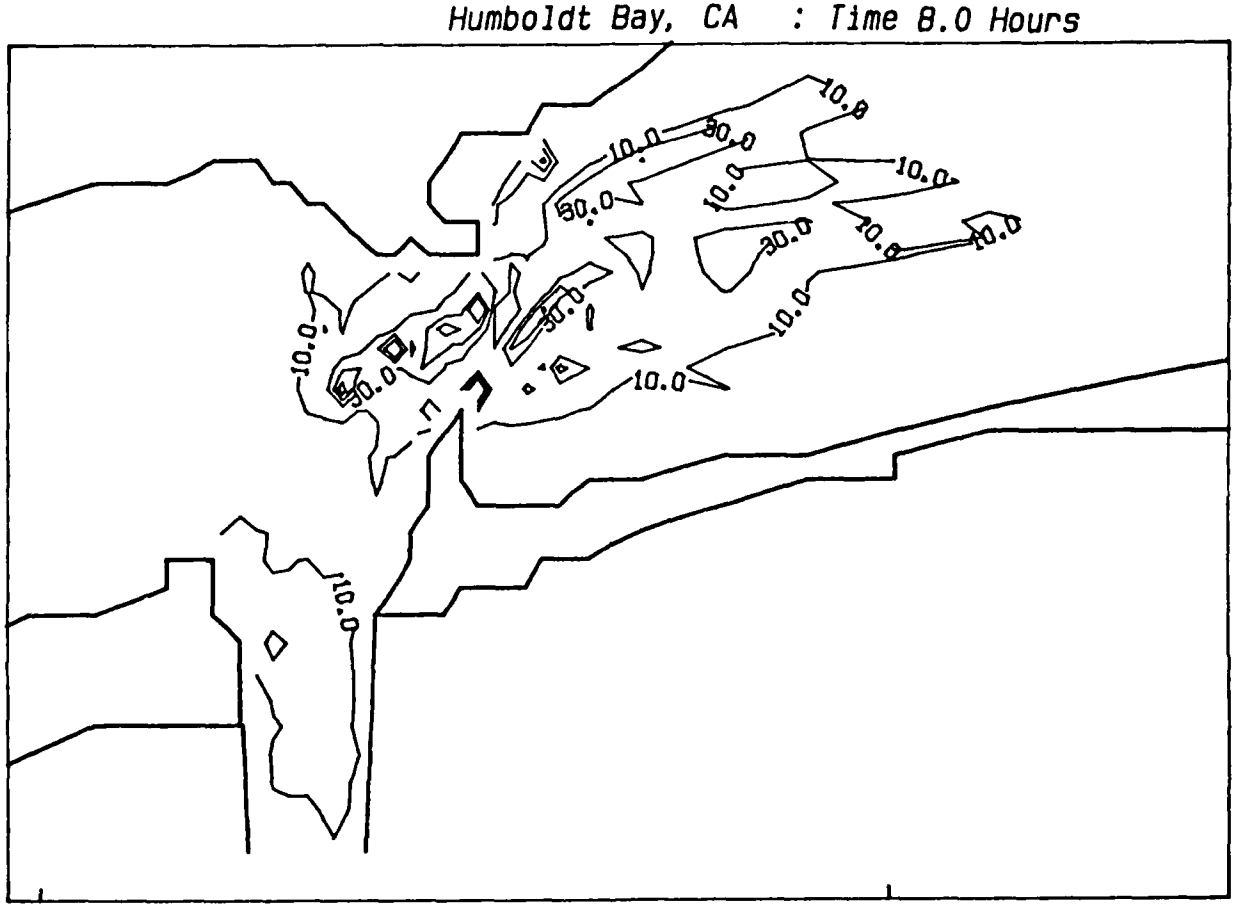
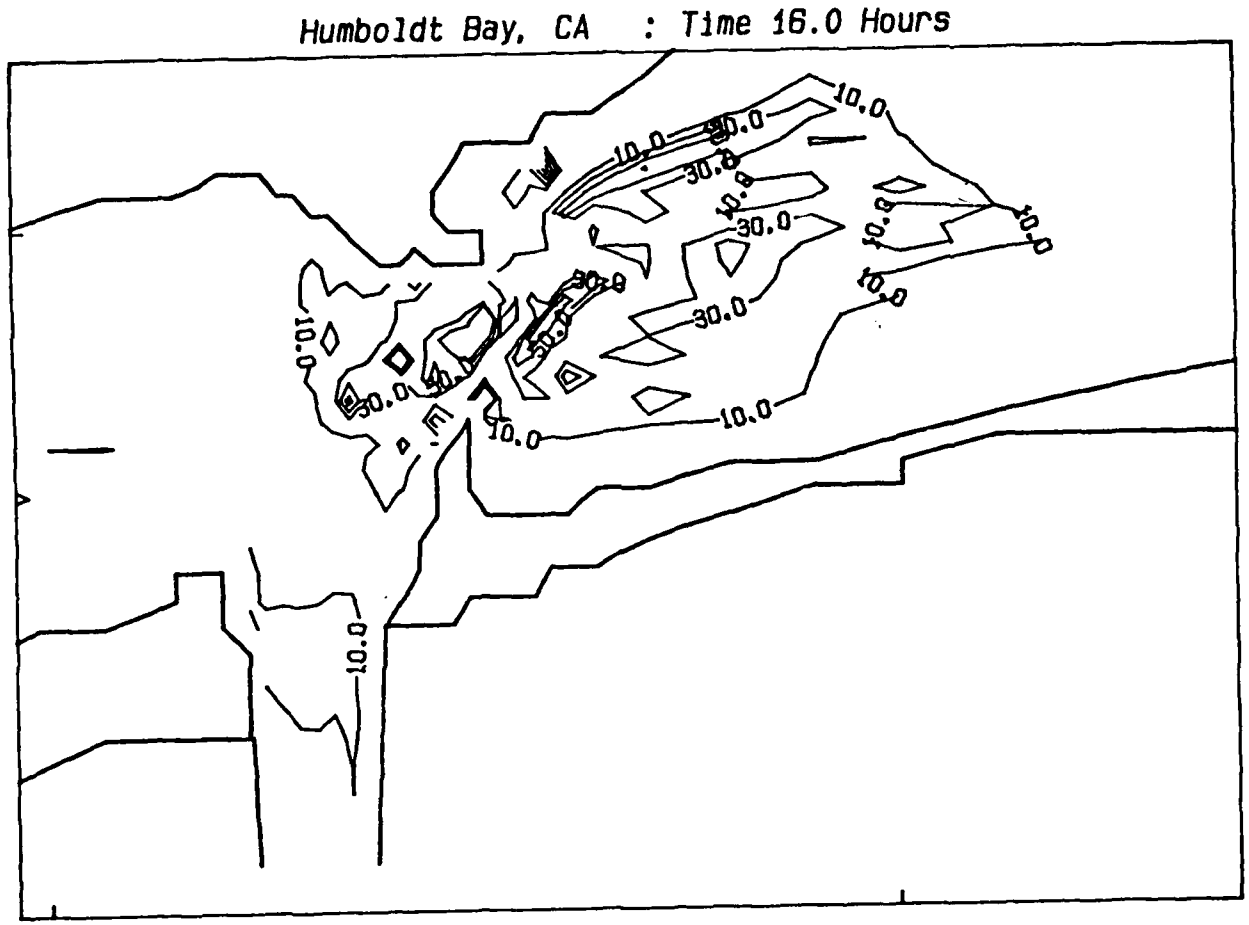
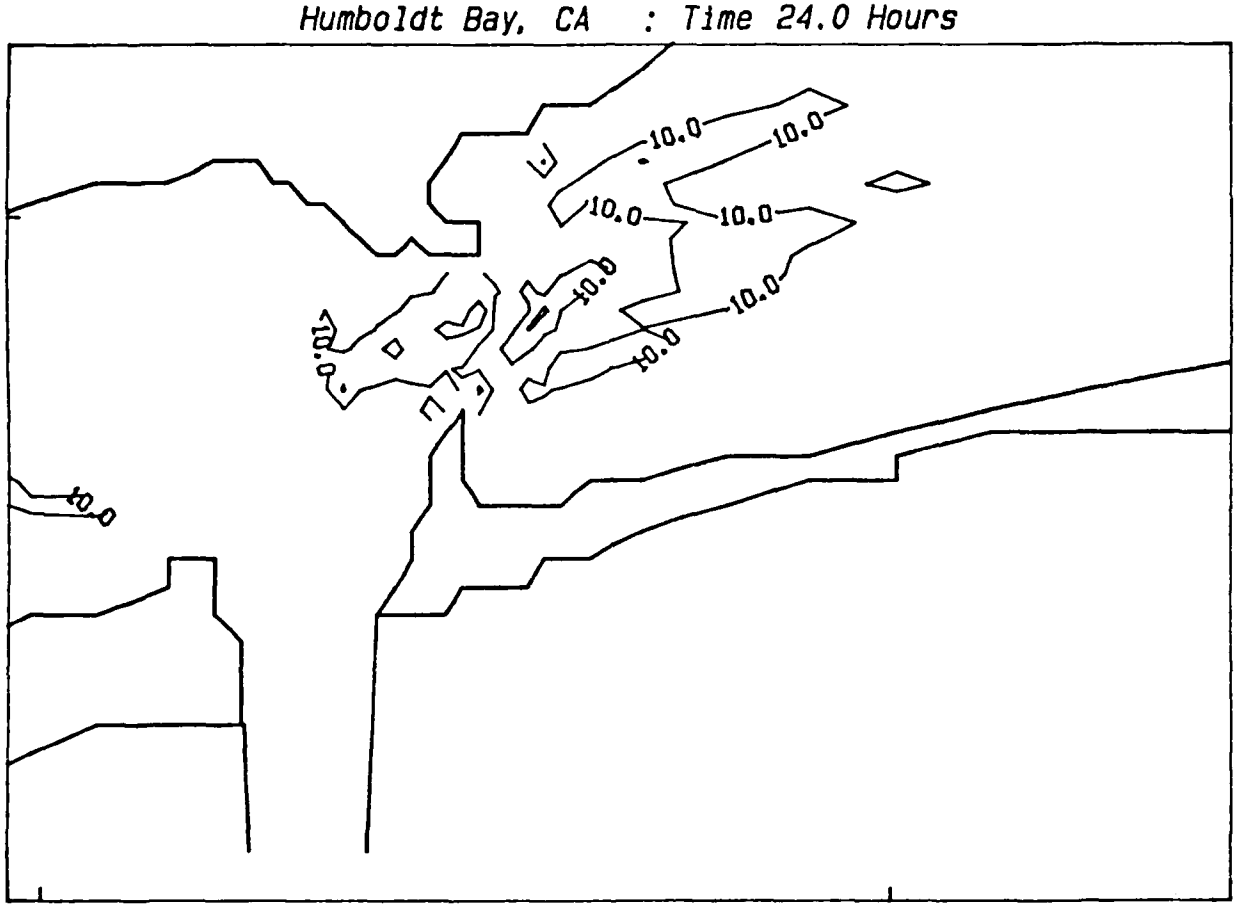


Plate 54. Bottom stress contours (dyne/cm^2) within Humboldt Bay at ebb tide: existing conditions



4 Contours
Contour Levels from 10. to 70.
Contour Interval of 20.

Plate 55. Bottom stress contours (dyne/cm^2) within Humboldt Bay at flood tide: existing conditions


Humboldt Bay, CA : Time 24.0 Hours
10.0
10.0
10.0

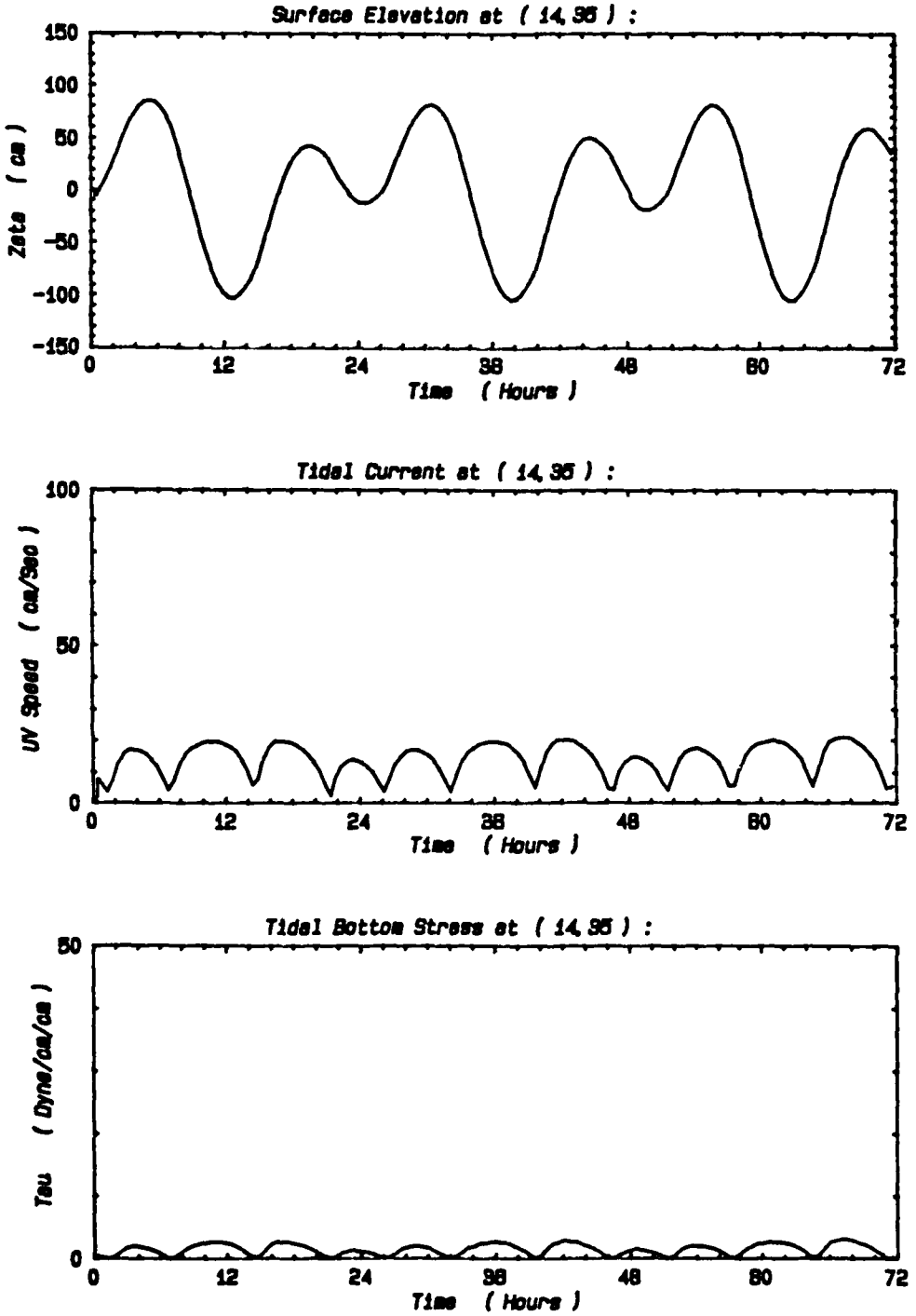


Plate 57. CELC3D computations of surface elevation, tidal currents, and bottom stresses at sta 1 (opposite north spit), 1-3 April 1982

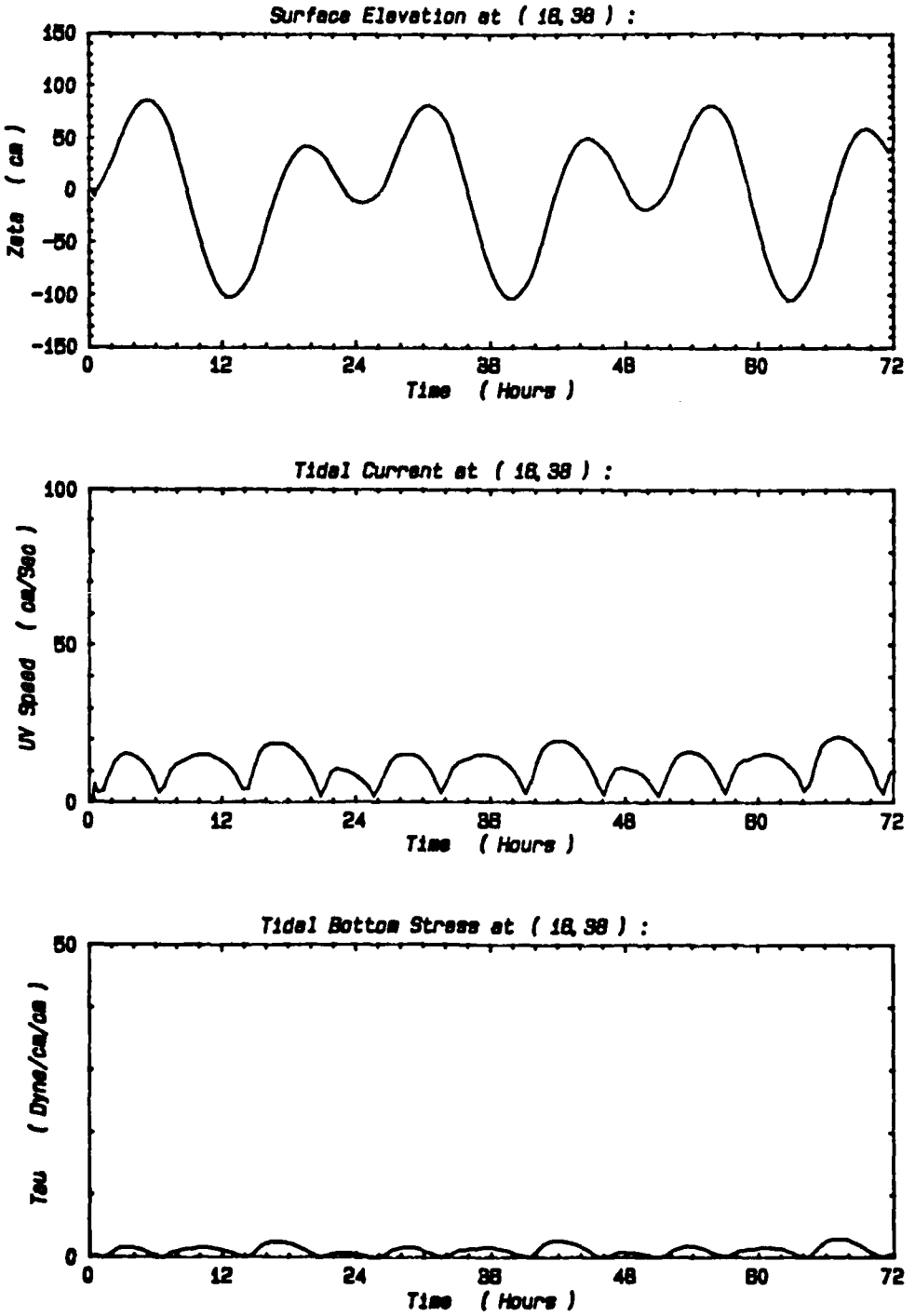


Plate 58. CELC3D computations of surface elevation, tidal currents, and bottom stresses at sta 4 (north of Buhne Point), 1-3 April 1982

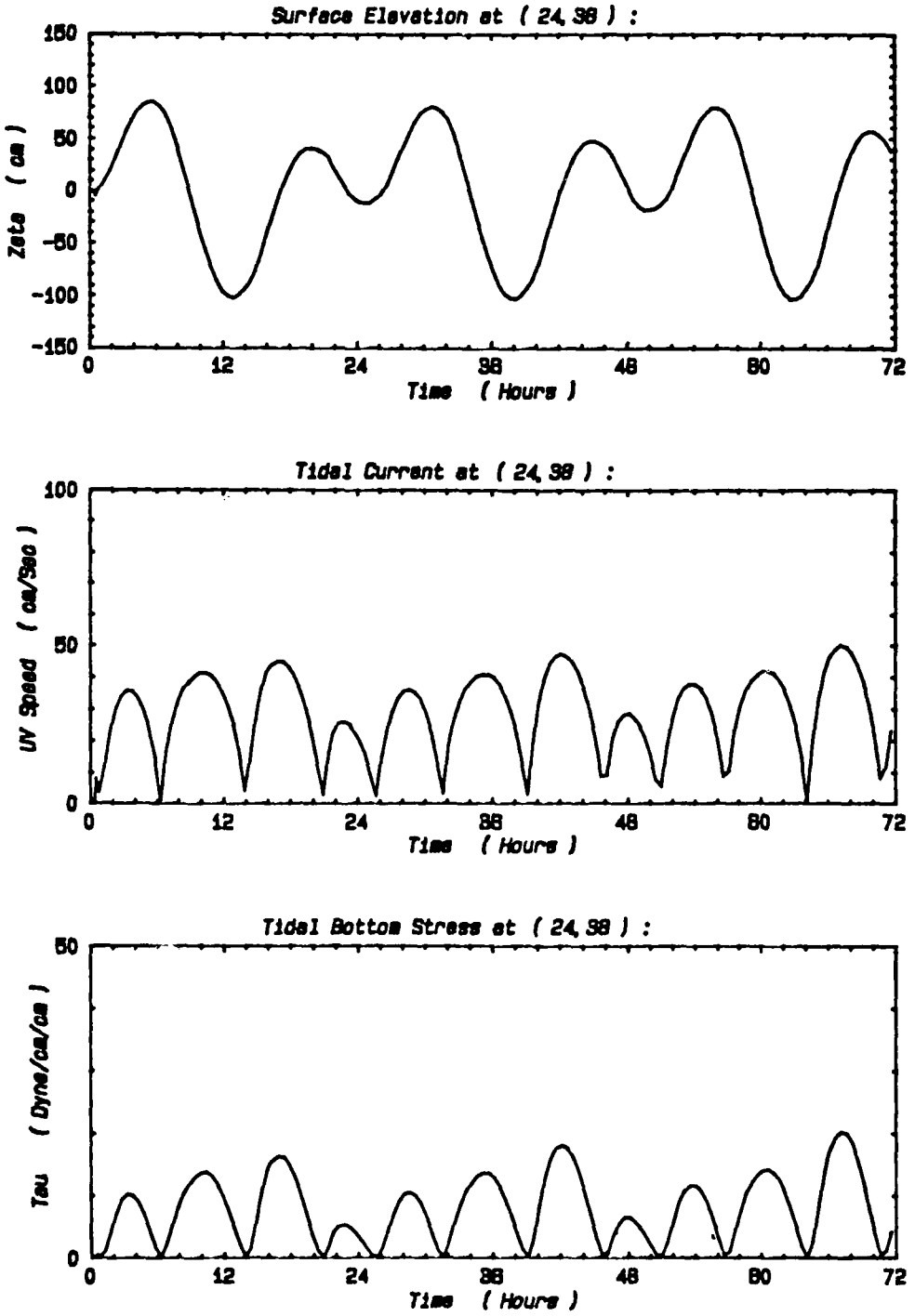


Plate 59. CELC3D computations of surface elevation, tidal currents, and bottom stresses at sta 11 (near Buhne Point), 1-3 April 1982

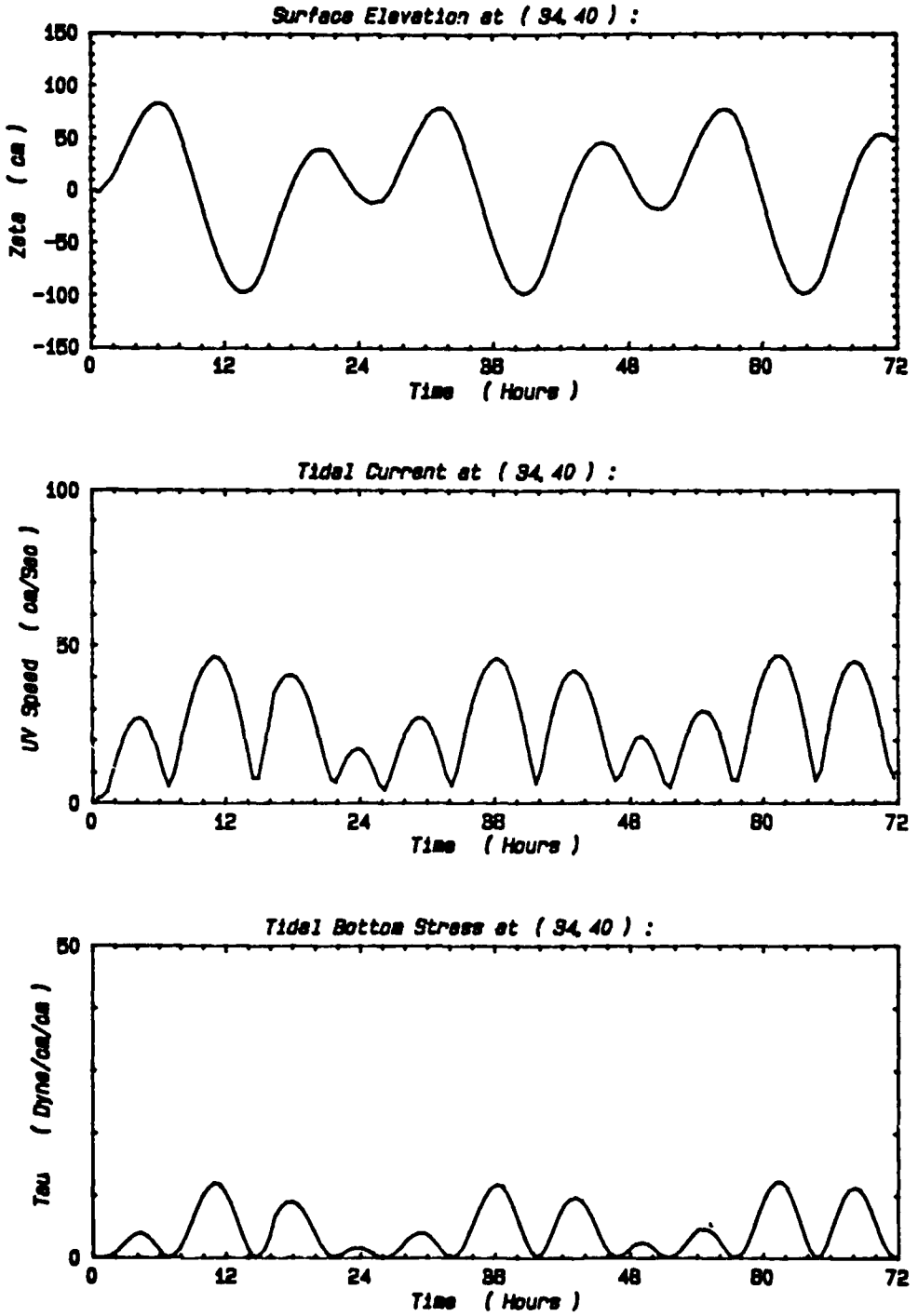


Plate 60. CELC3D computations of surface elevation, tidal currents, and bottom stresses at sta 13 (Fields Landing Channel), 1-3 April 1982

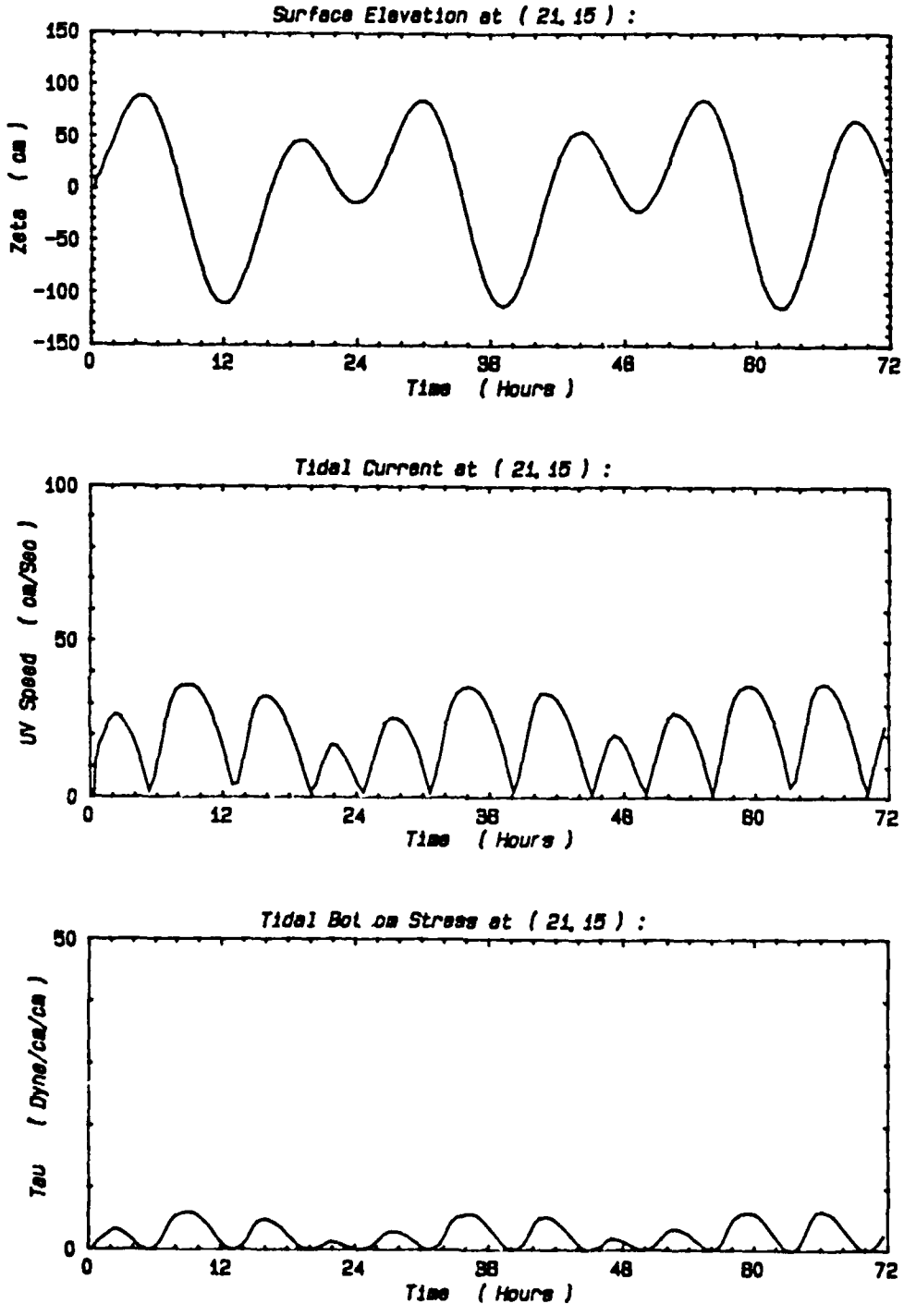
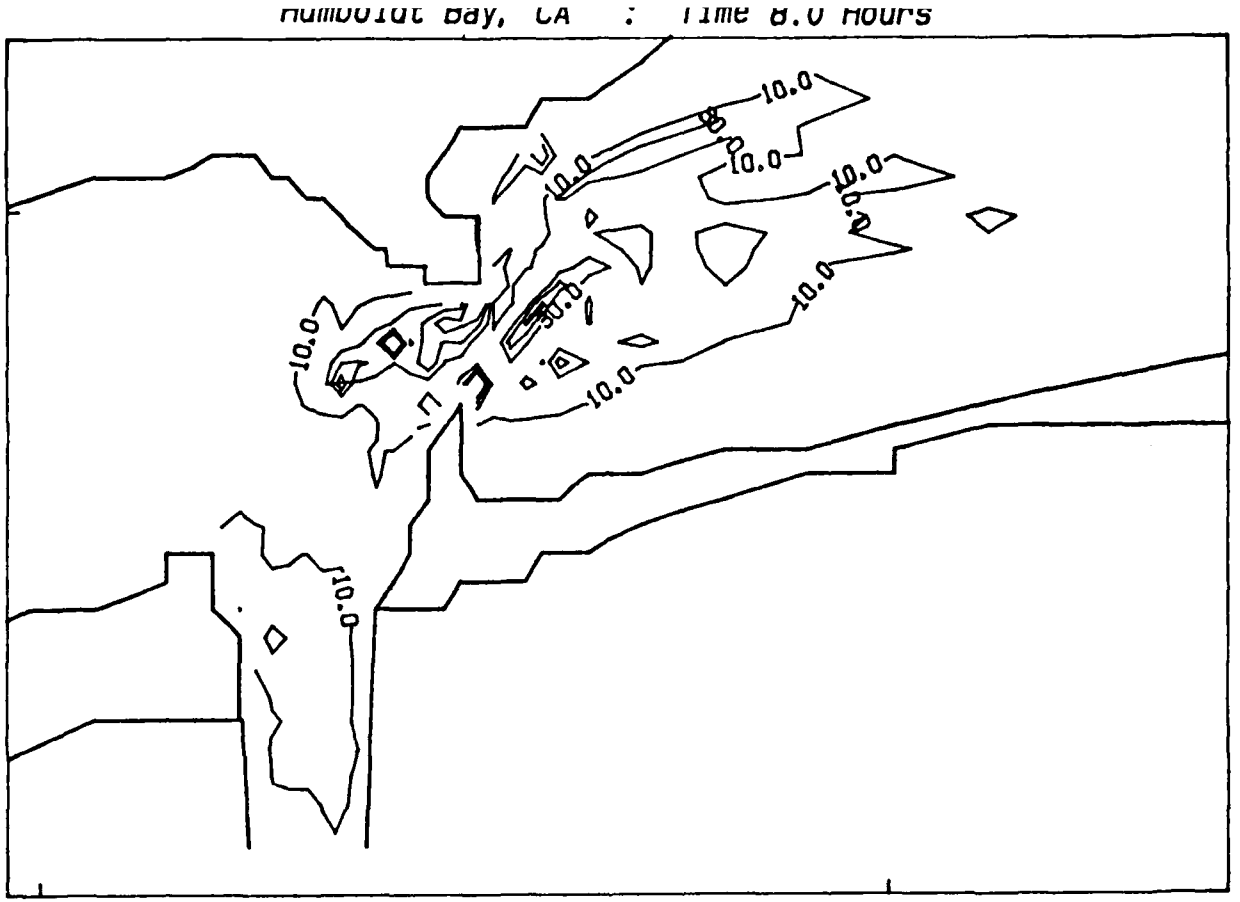
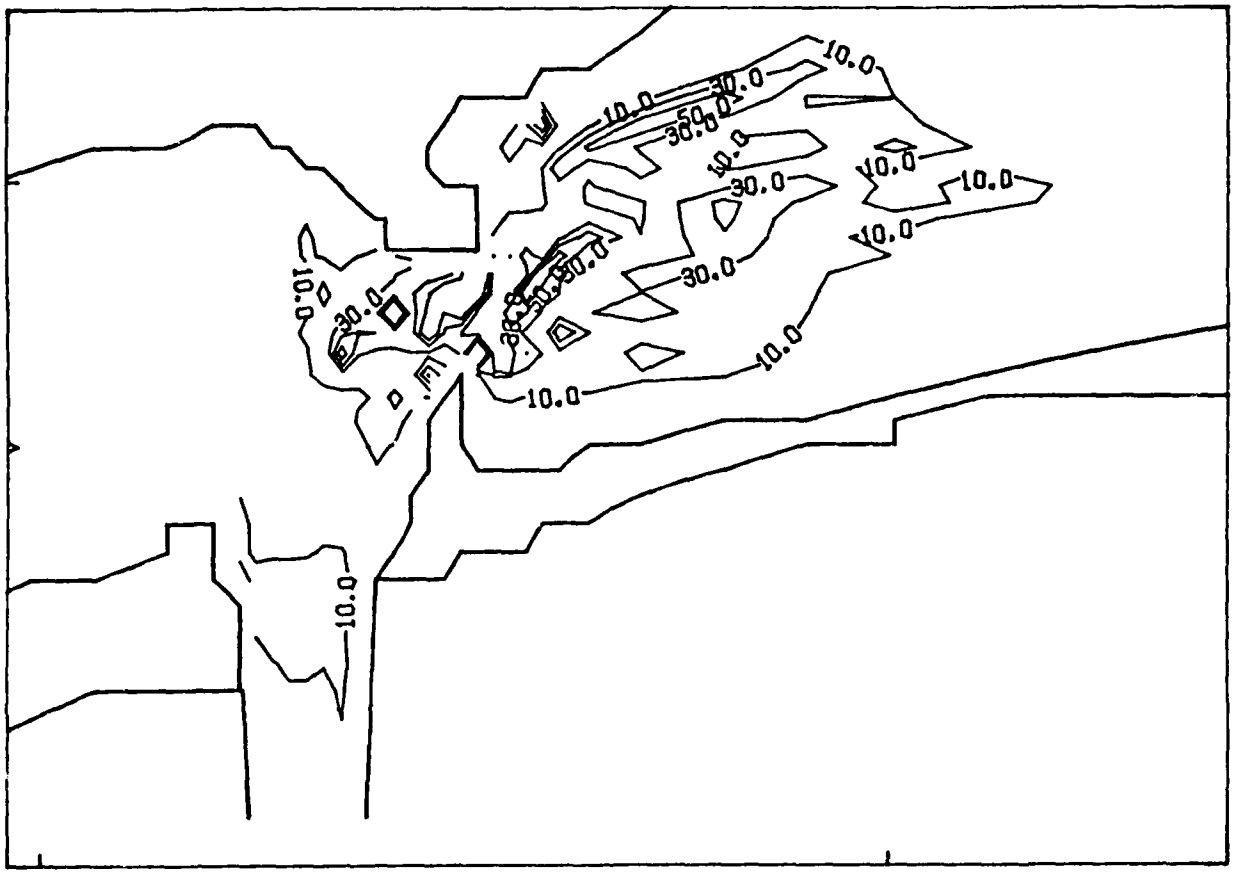


Plate 61. CELC3D computations of surface elevation, tidal currents, and bottom stresses at sta 16 (Humboldt Bay Entrance), 1-3 April 1982



4 Contours
Contour Levels from 10. to 70.
Contour Interval of 20.

Plate 62. Bottom stress contours (dyne/cm^2) within Humboldt Bay at ebb tide: proposed improvement plan

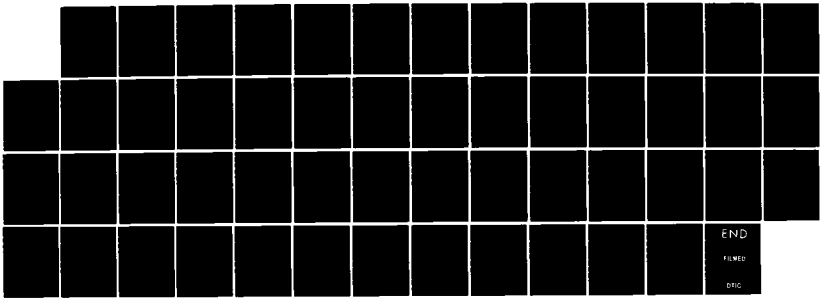


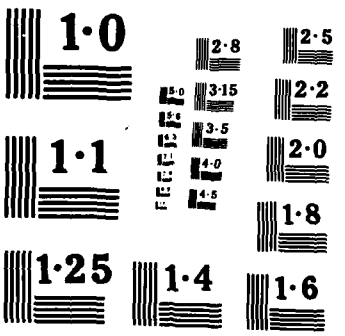
4 Contours
Contour Levels from 10. to 70.
Contour Interval of 20.

Plate 63. Bottom stress contours (dyne/cm^2) within Humboldt Bay at flood tide: proposed improvement plan

AD-A152 327 BUHNE POINT HUMBOLDT BAY CALIFORNIA DESIGN FOR THE PREVENTION OF SHORELIN..(U) COASTAL ENGINEERING RESEARCH CENTER VICKSBURG MS R R BOTTIN ET AL. NOV 84 CERC-84-5 4/4

UNCLASSIFIED F/G 13/2 NL




1·0
1·1
1·25
1·4
1·6
1·8
2·0
2·2
2·5
2·8
3·15
3·5
4·0
4·5

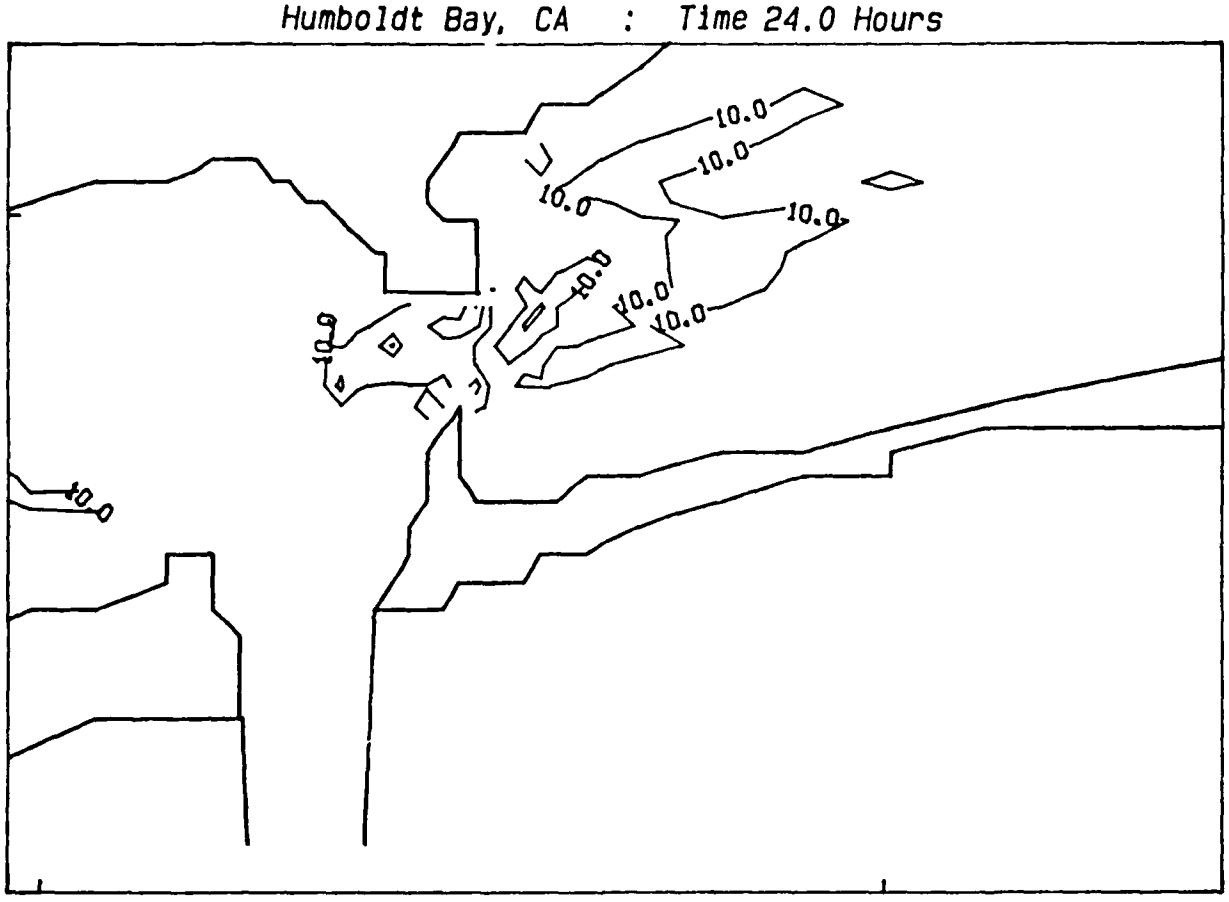


Plate 64. Bottom stress contours (dyne/cm^2) within Humboldt Bay at slack water: proposed improvement plan

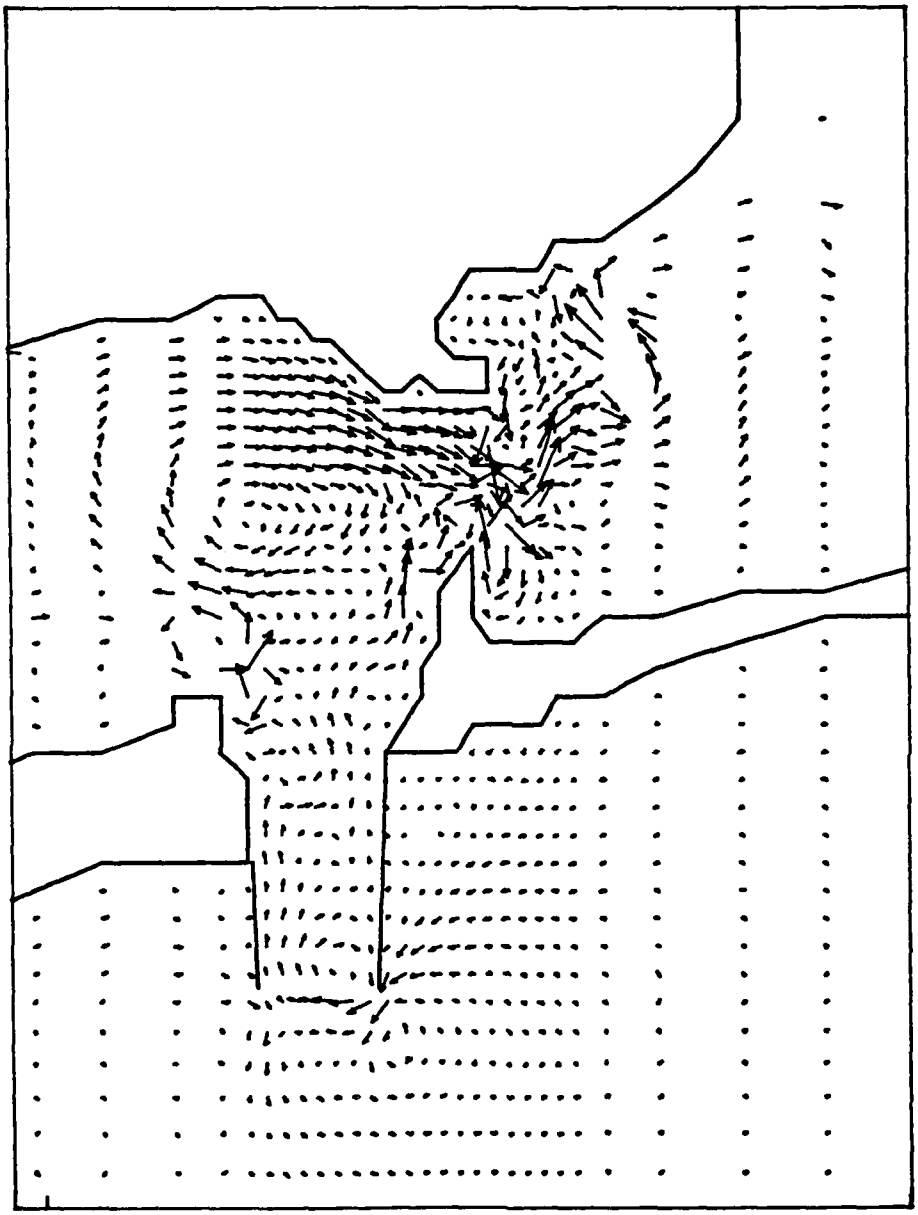


Plate 65. Tidally induced residual currents within Humboldt Bay, 1-3 April 1982, existing conditions

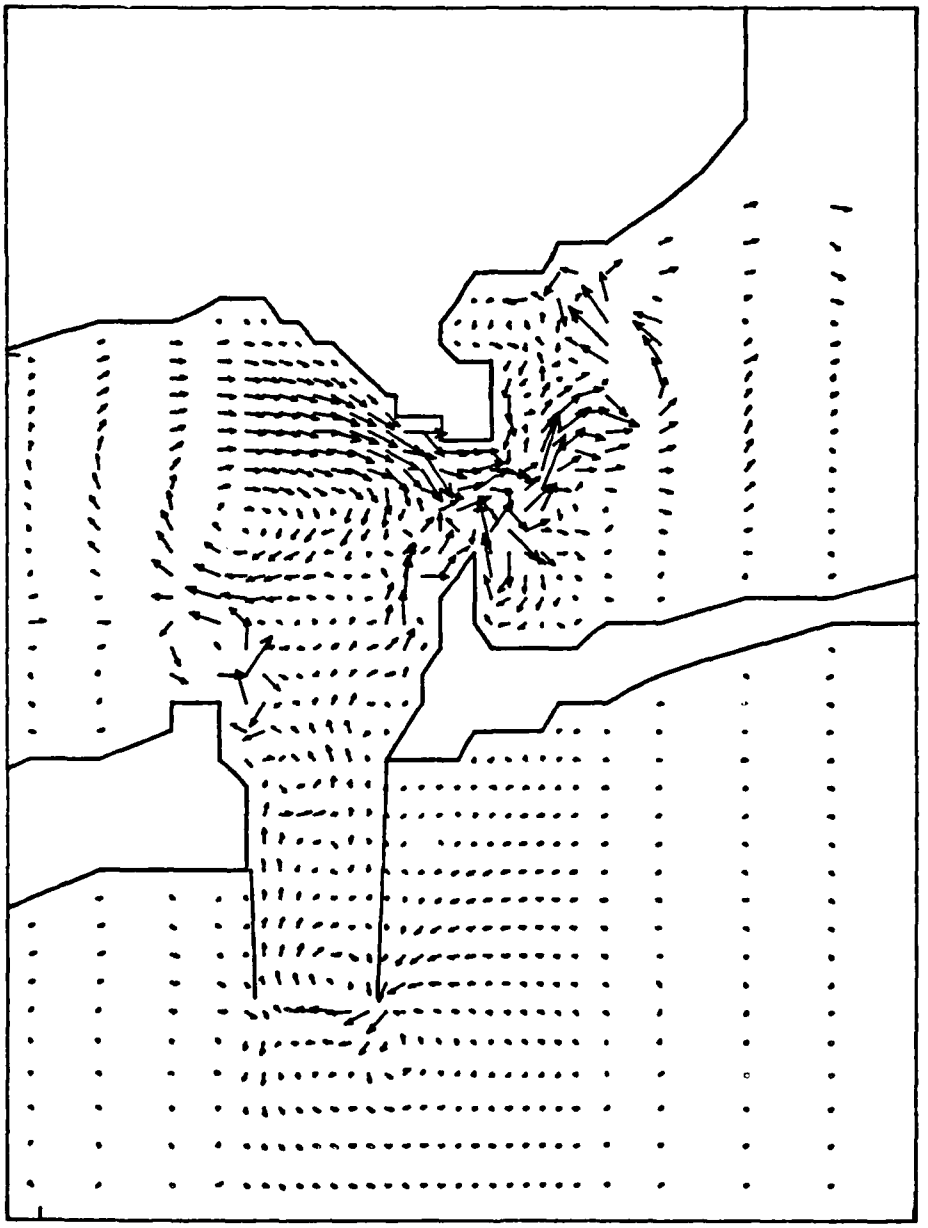


Plate 66. Tidally induced residual currents within Humboldt Bay, 1-3 April 1982, proposed improvement plan

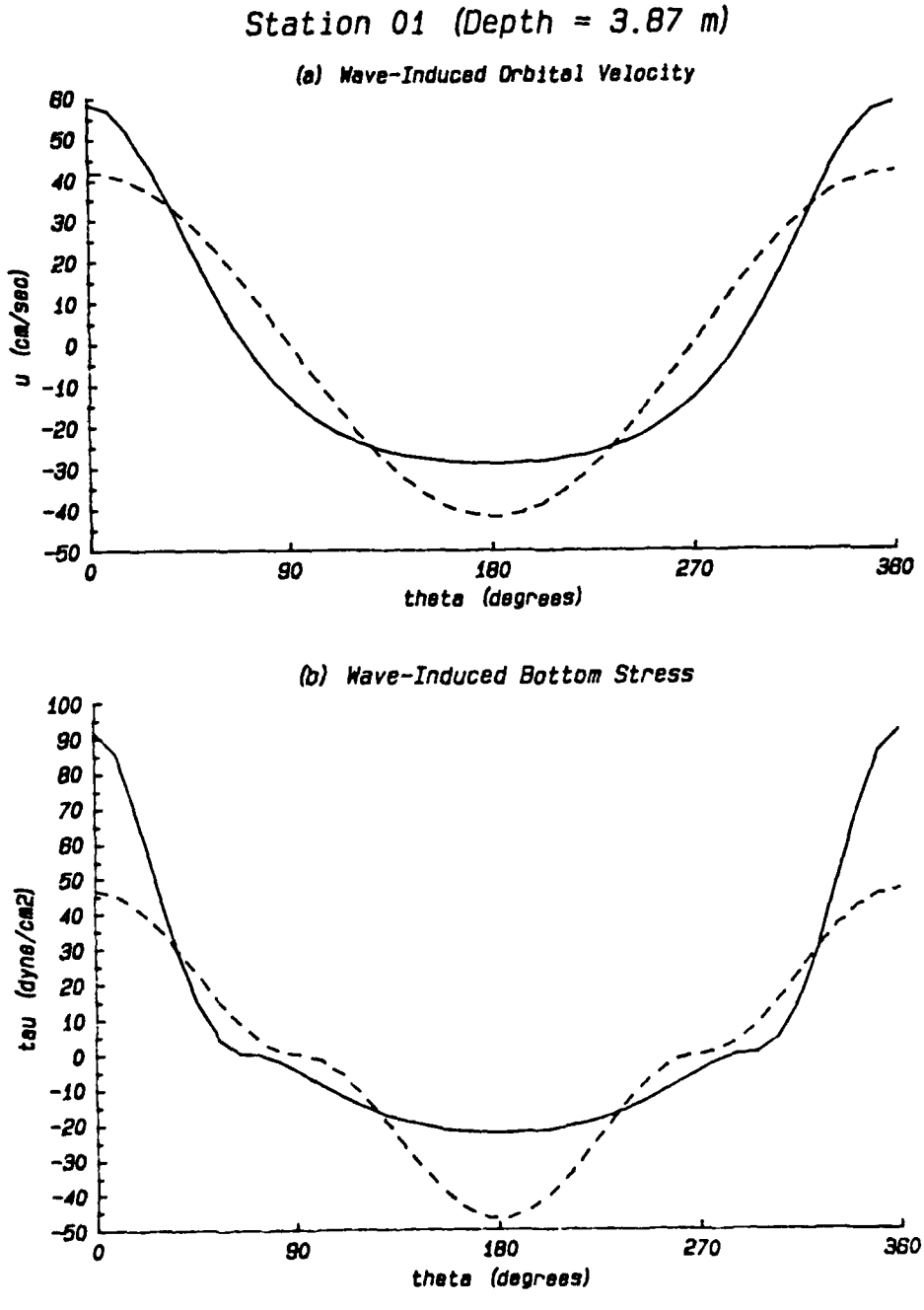


Plate 67. Wave-induced bottom orbital velocity and bottom stress at sta 1; 11-sec, 10-ft waves from the northwest; maximum flood; +3.2 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

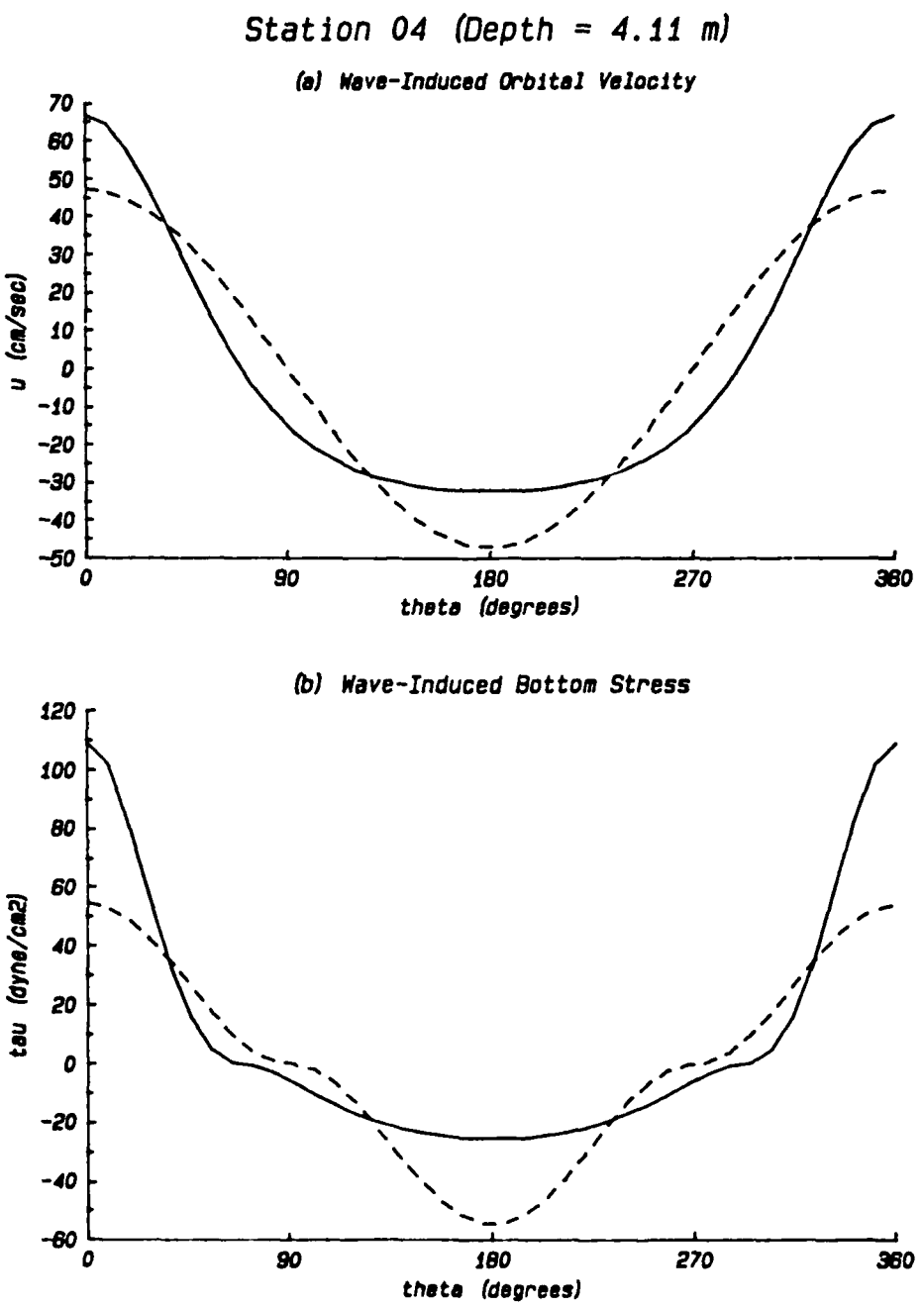


Plate 68. Wave-induced bottom orbital velocity and bottom stress at sta 4; 11-sec, 10-ft waves from the northwest; maximum flood; +3.2 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

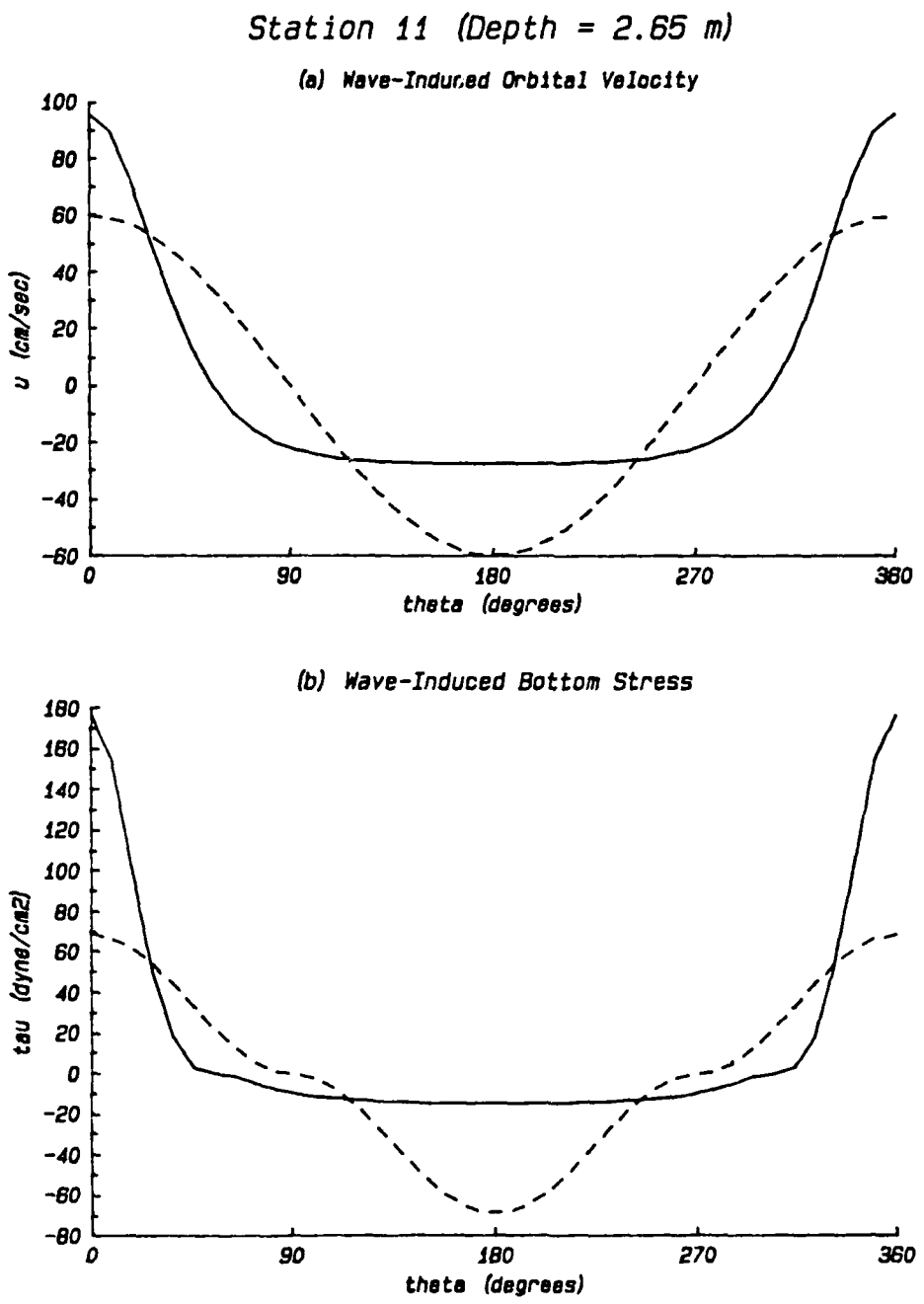


Plate 69. Wave-induced bottom orbital velocity and bottom stress at sta 11; 11-sec, 10-ft waves from the northwest; maximum flood; +3.2 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

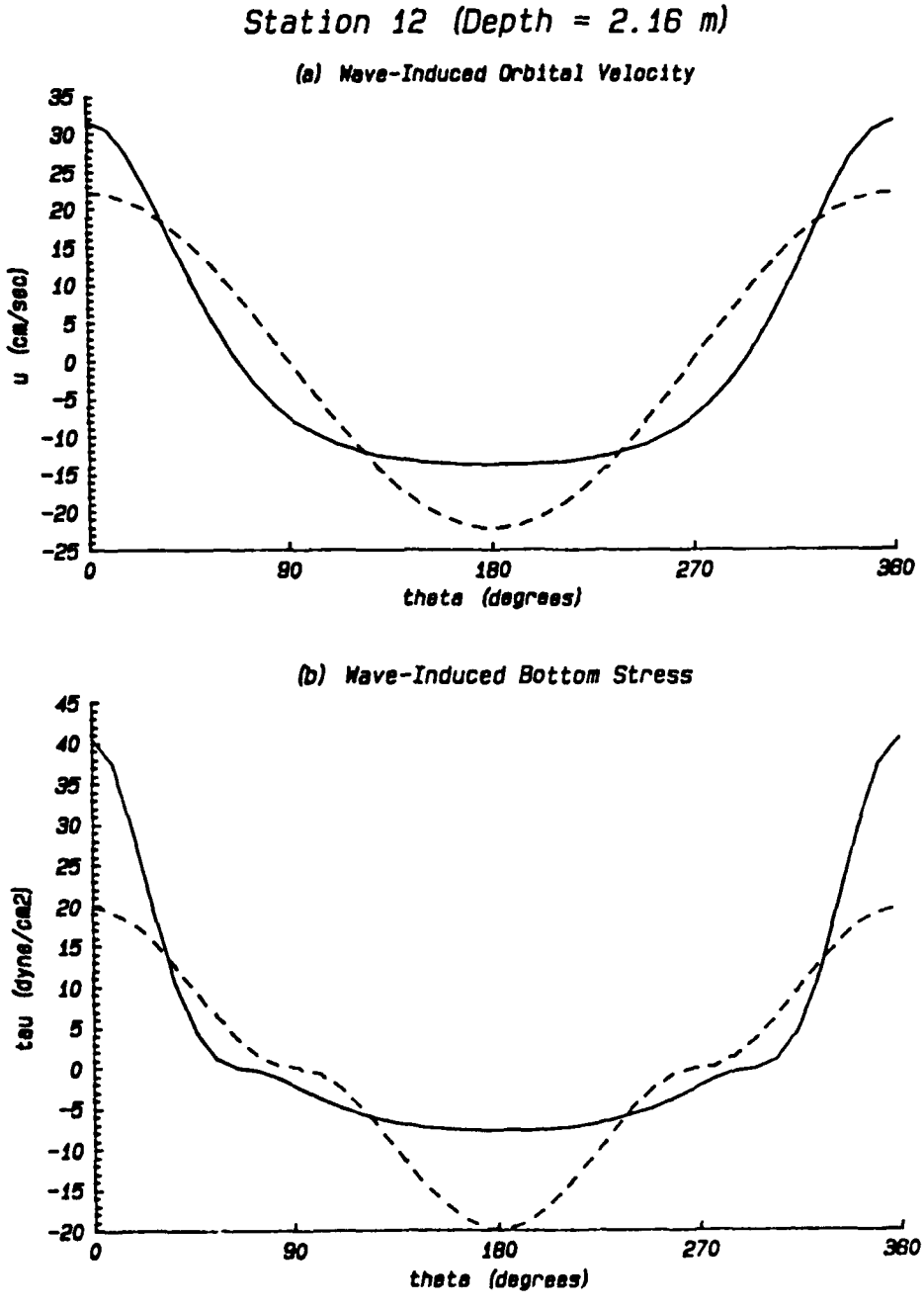


Plate 70. Wave-induced bottom orbital velocity and bottom stress at sta 12; 11-sec, 10-ft waves from the northwest; maximum flood; +3.2 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

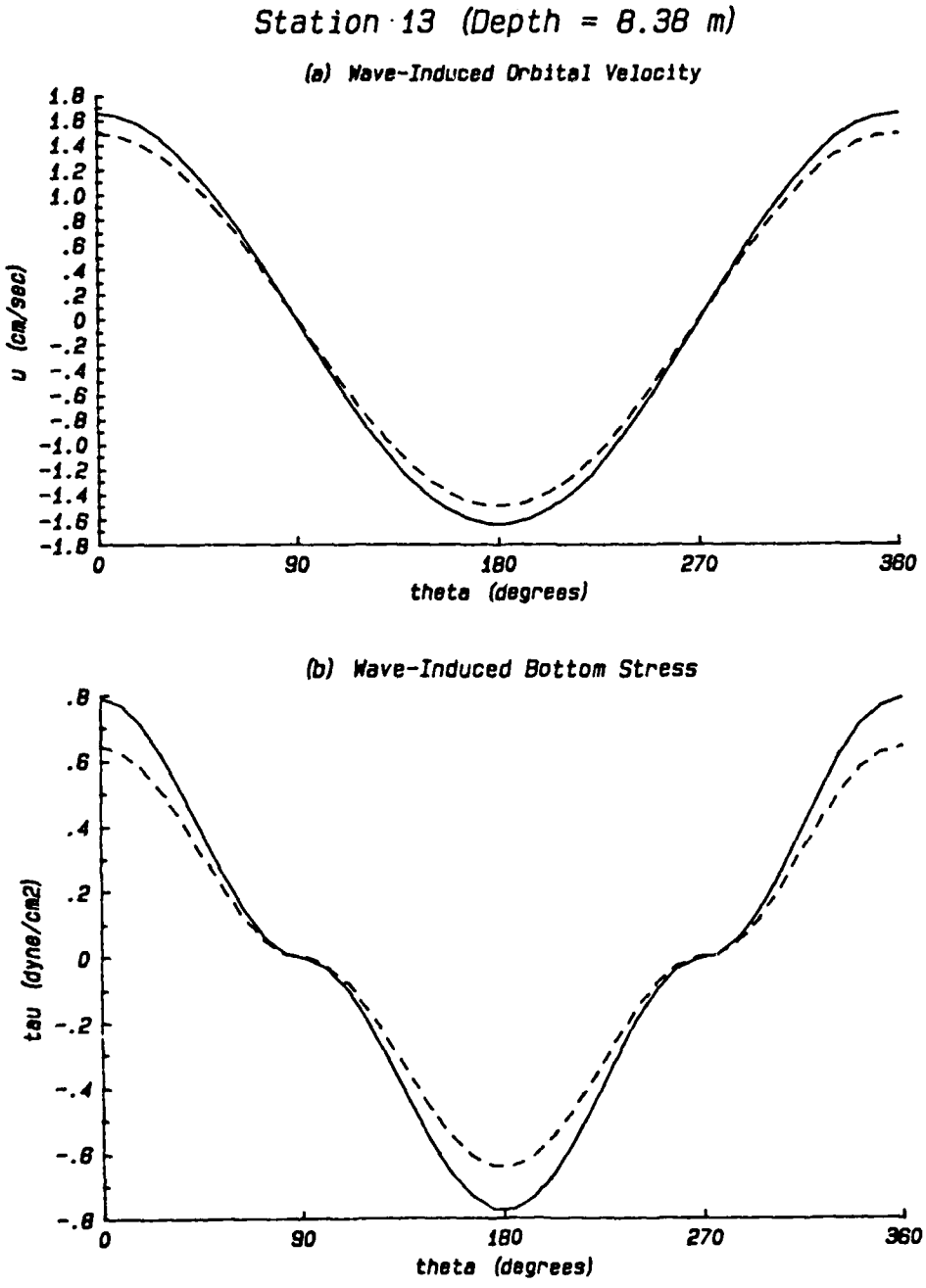


Plate 71. Wave-induced bottom orbital velocity and bottom stress at sta 13; 11-sec, 10-ft waves from the northwest; maximum flood; +3.2 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

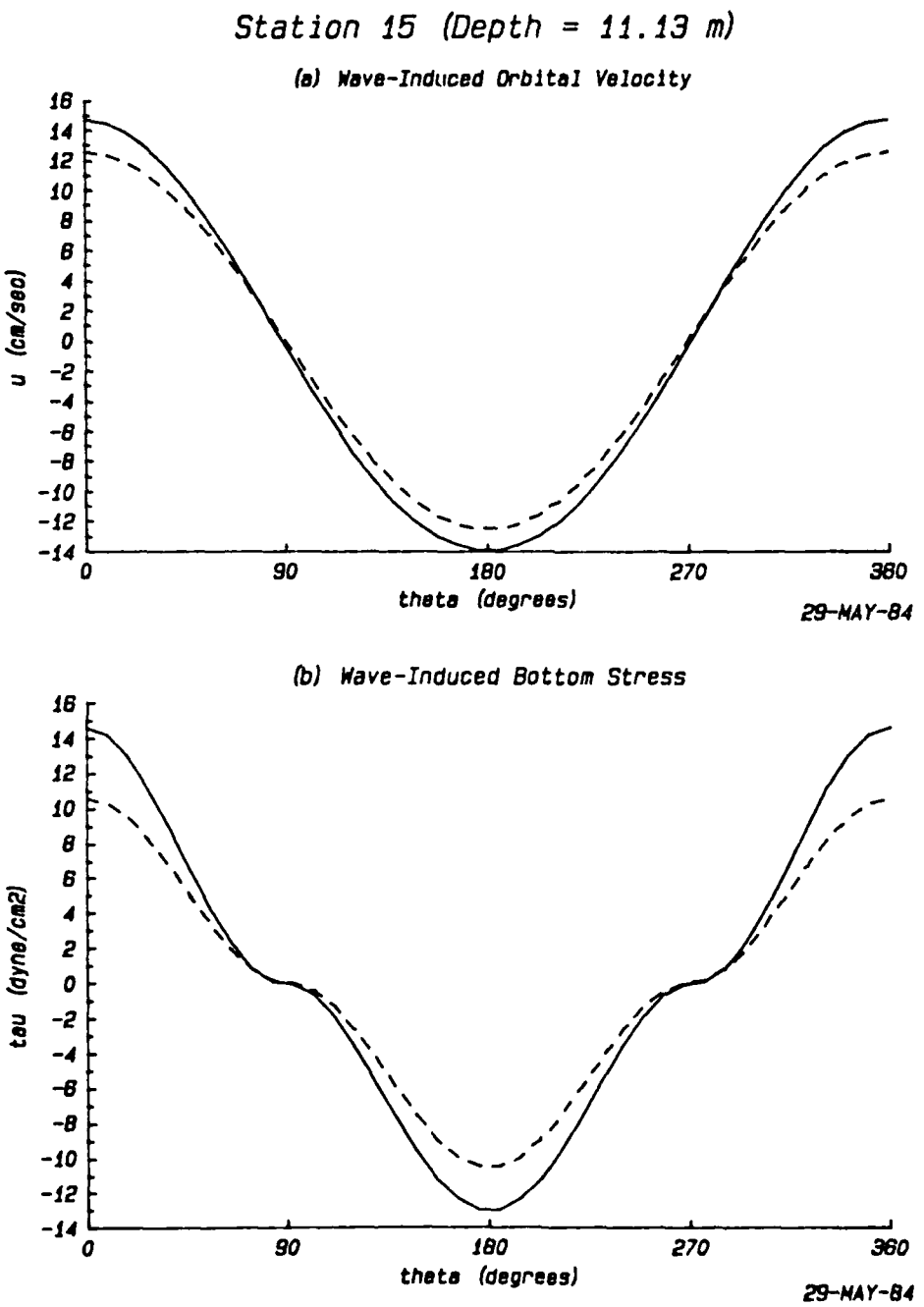


Plate 72. Wave-induced bottom orbital velocity and bottom stress at sta 15; 11-sec, 10-ft waves from the northwest; maximum flood; +3.2 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

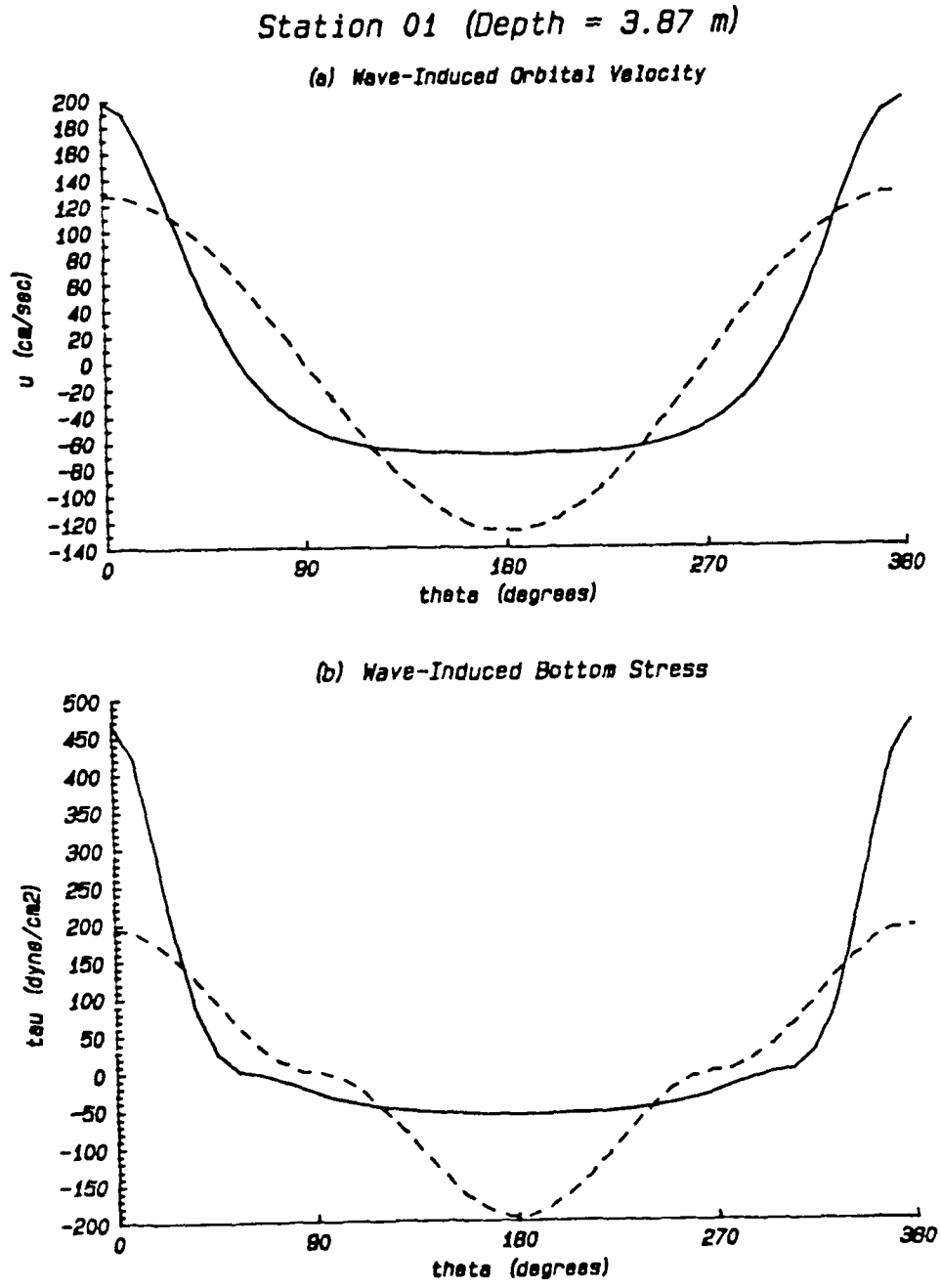


Plate 73. Wave-induced bottom orbital velocity and bottom stress at sta 1; 11-sec, 10-ft waves from the northwest; maximum ebb; +3.7 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

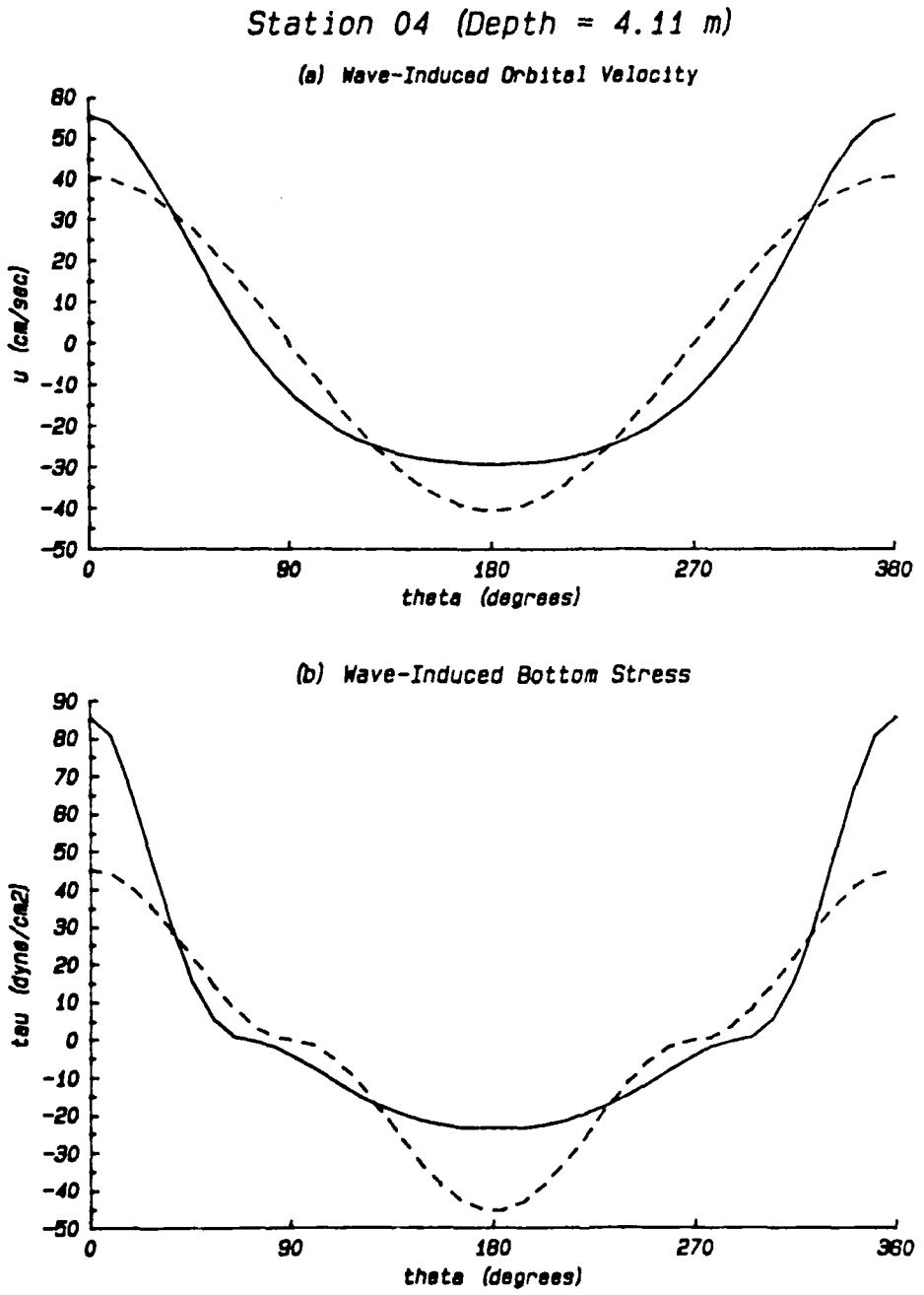


Plate 74. Wave-induced bottom orbital velocity and bottom stress at sta 4; 11-sec, 10-ft waves from the northwest; maximum ebb; +3.7 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

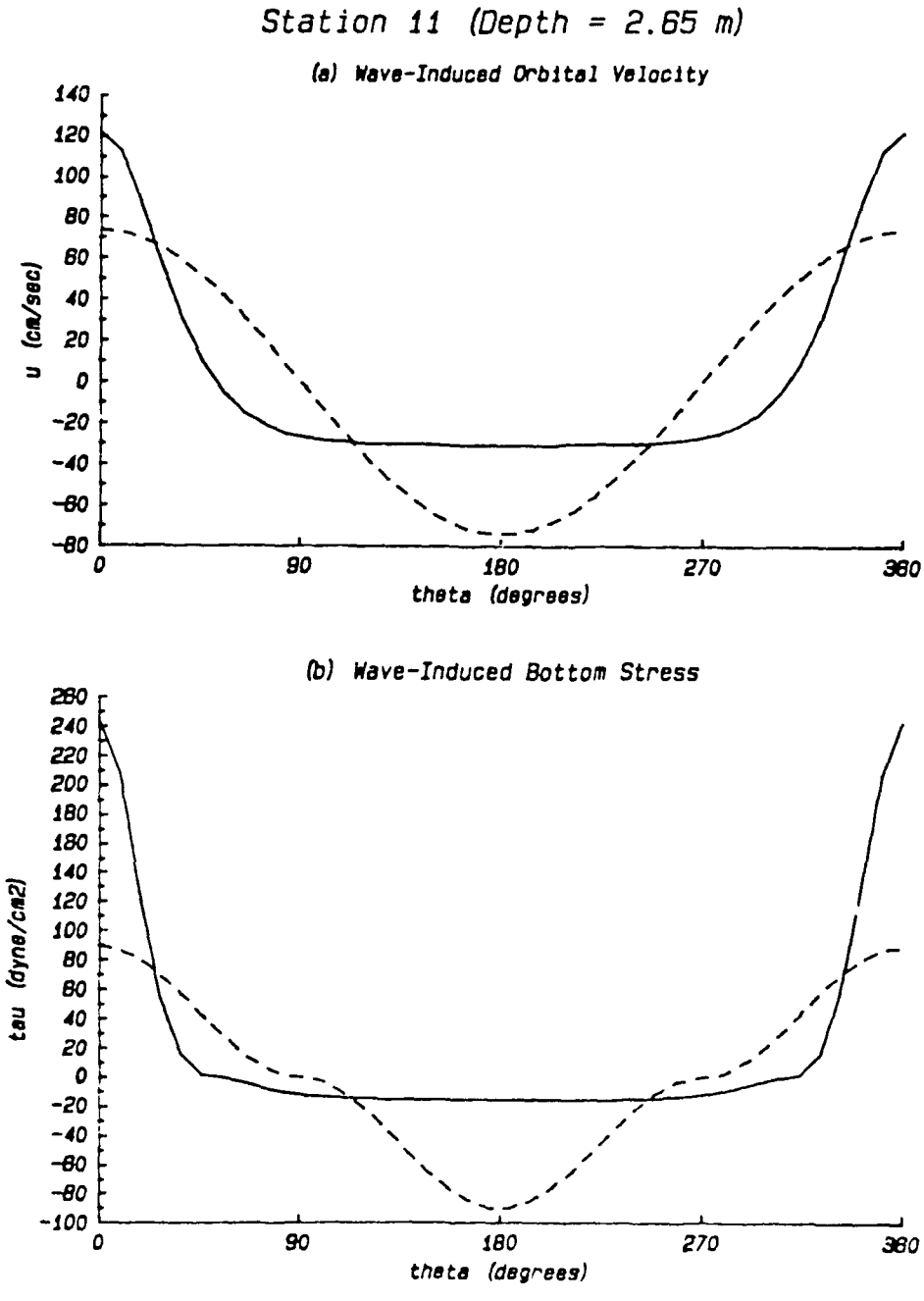


Plate 75. Wave-induced bottom orbital velocity and bottom stress at sta 11; 11-sec, 10-ft waves from the northwest; maximum ebb; +3.7 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

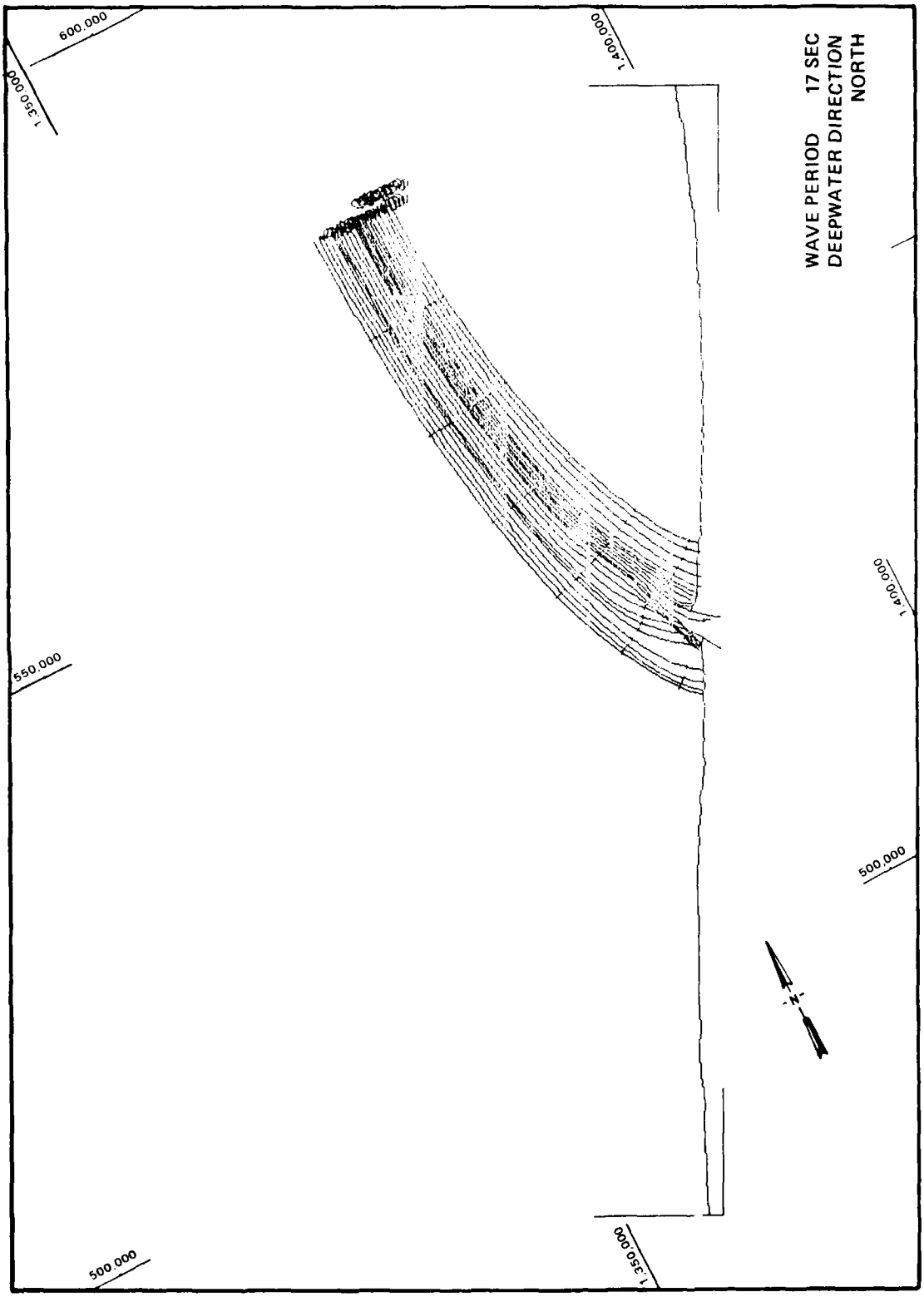

600,000
1,400,000
1,350,000
WAVE PERIOD 17 SEC
DEEPWATER DIRECTION NORTH
1,400,000
550,000
500,000
N
500,000
1,350,000

PLATE A8

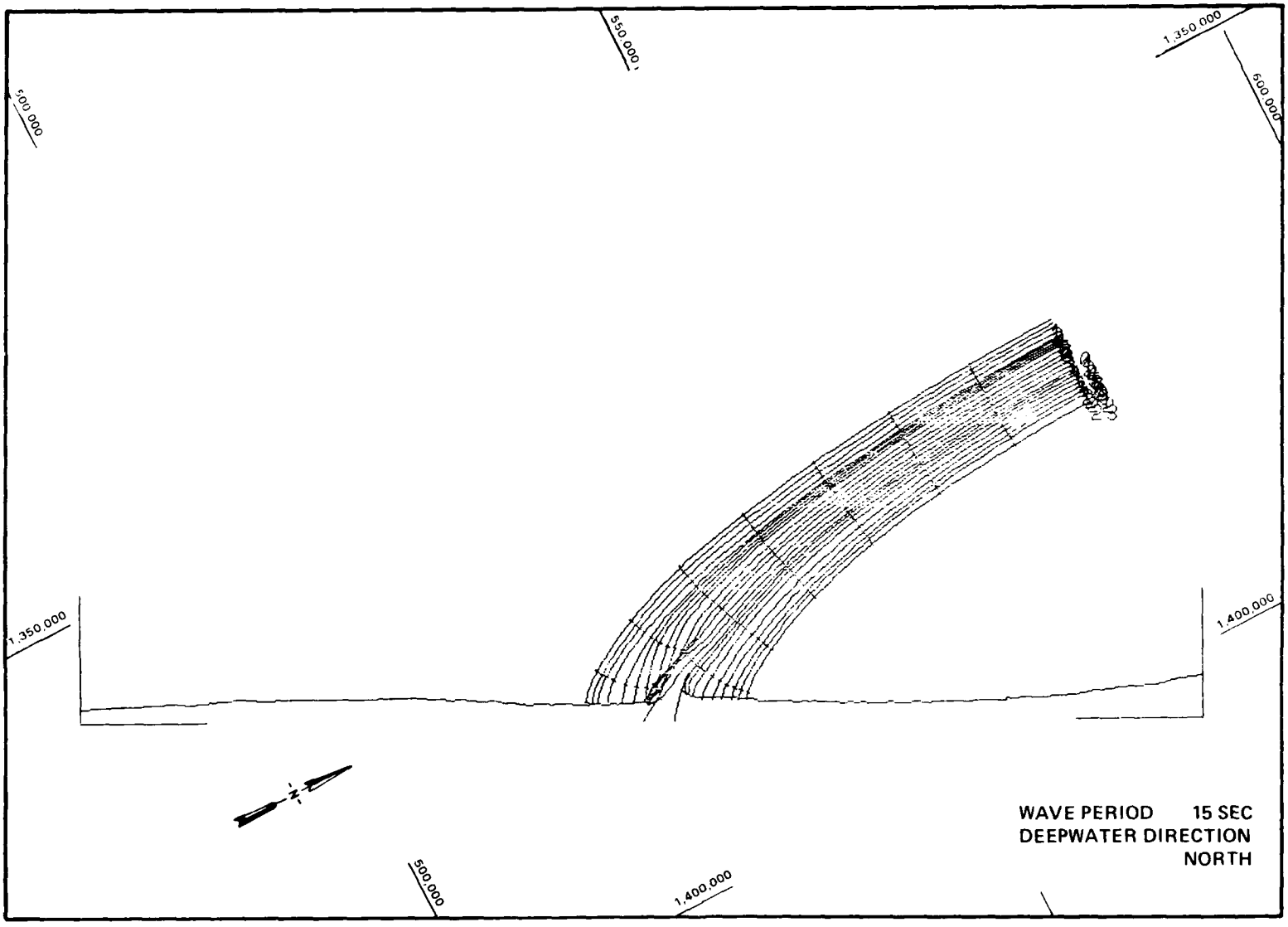

550,000
1,350,000
500,000
500,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 15 SEC
DEEPWATER DIRECTION
NORTH

PLATE A7

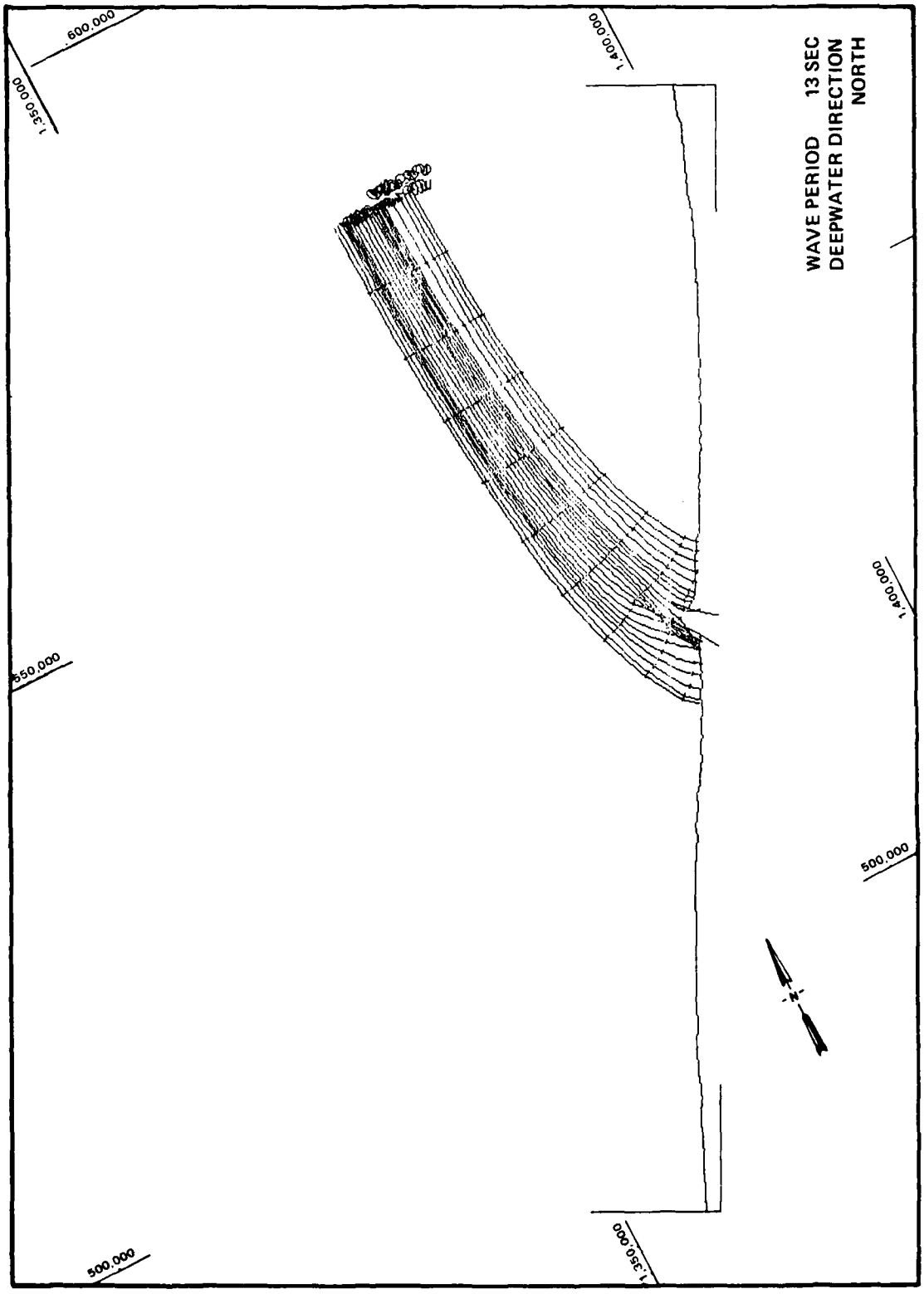

600,000
1,400,000
1,350,000
WAVE PERIOD 13 SEC
DEEPWATER DIRECTION NORTH
550,000
1,400,000
500,000
1,350,000
500,000
N

PLATE A6

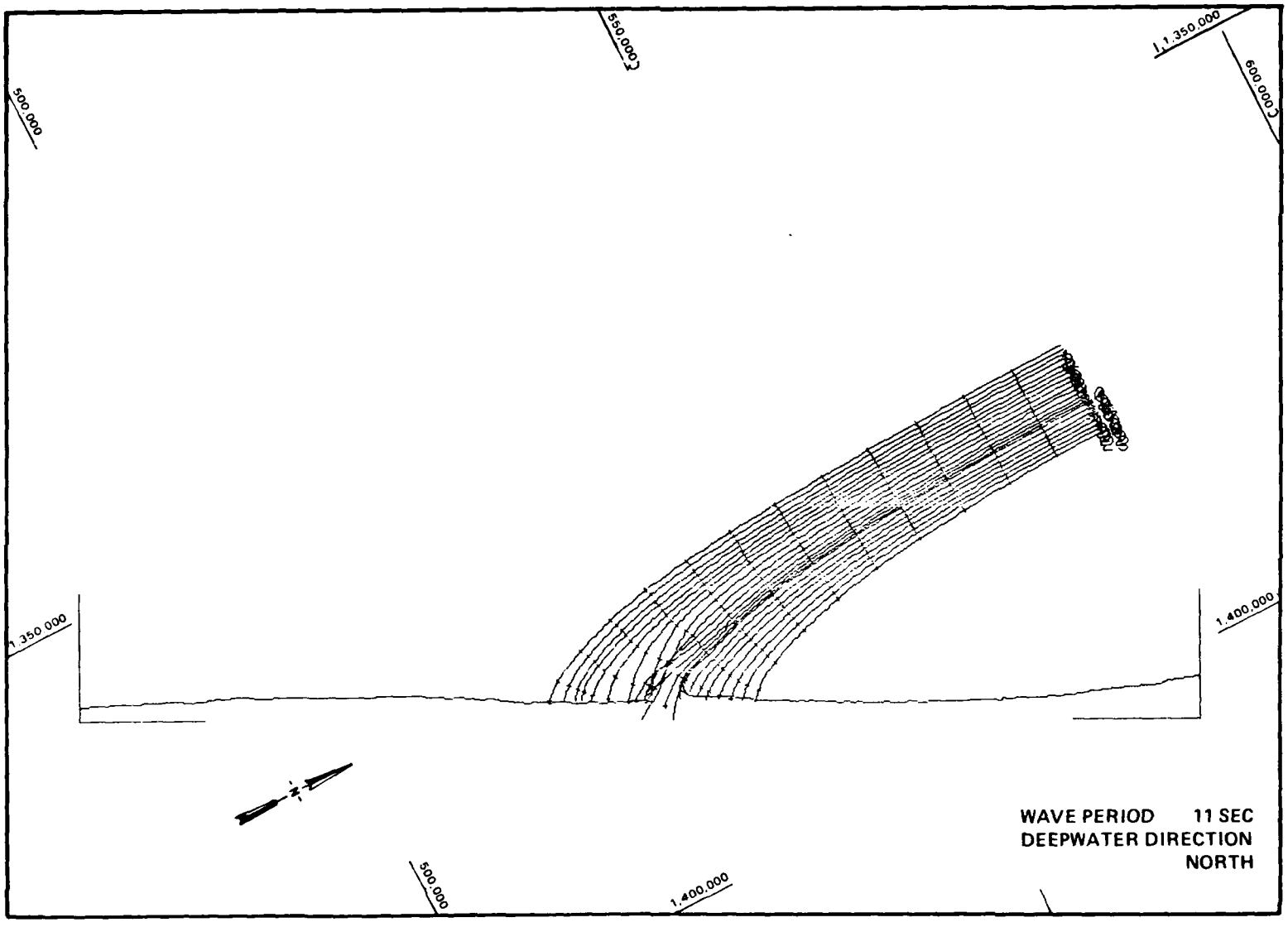

550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 11 SEC
DEEPWATER DIRECTION
NORTH

PLATE A5

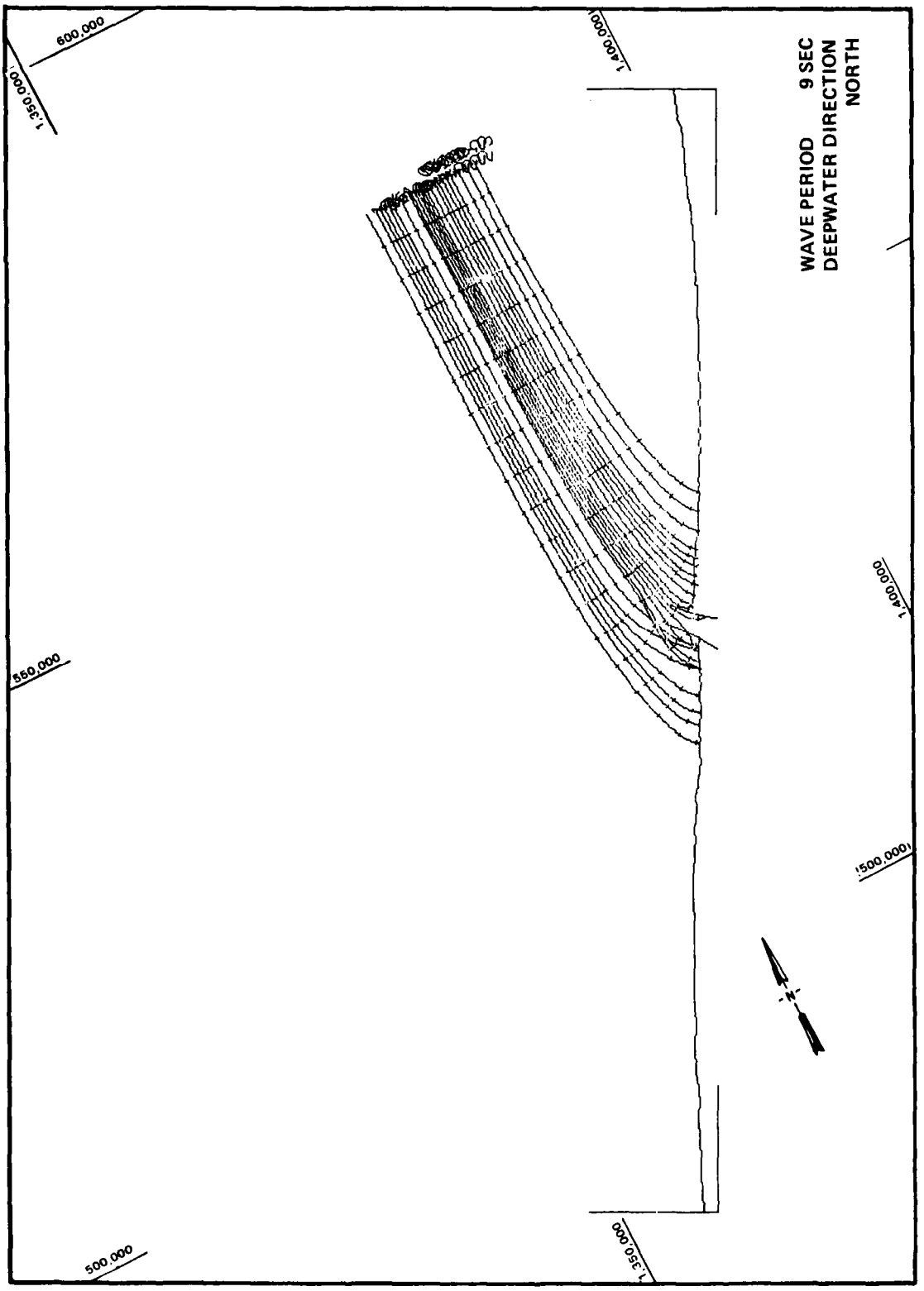
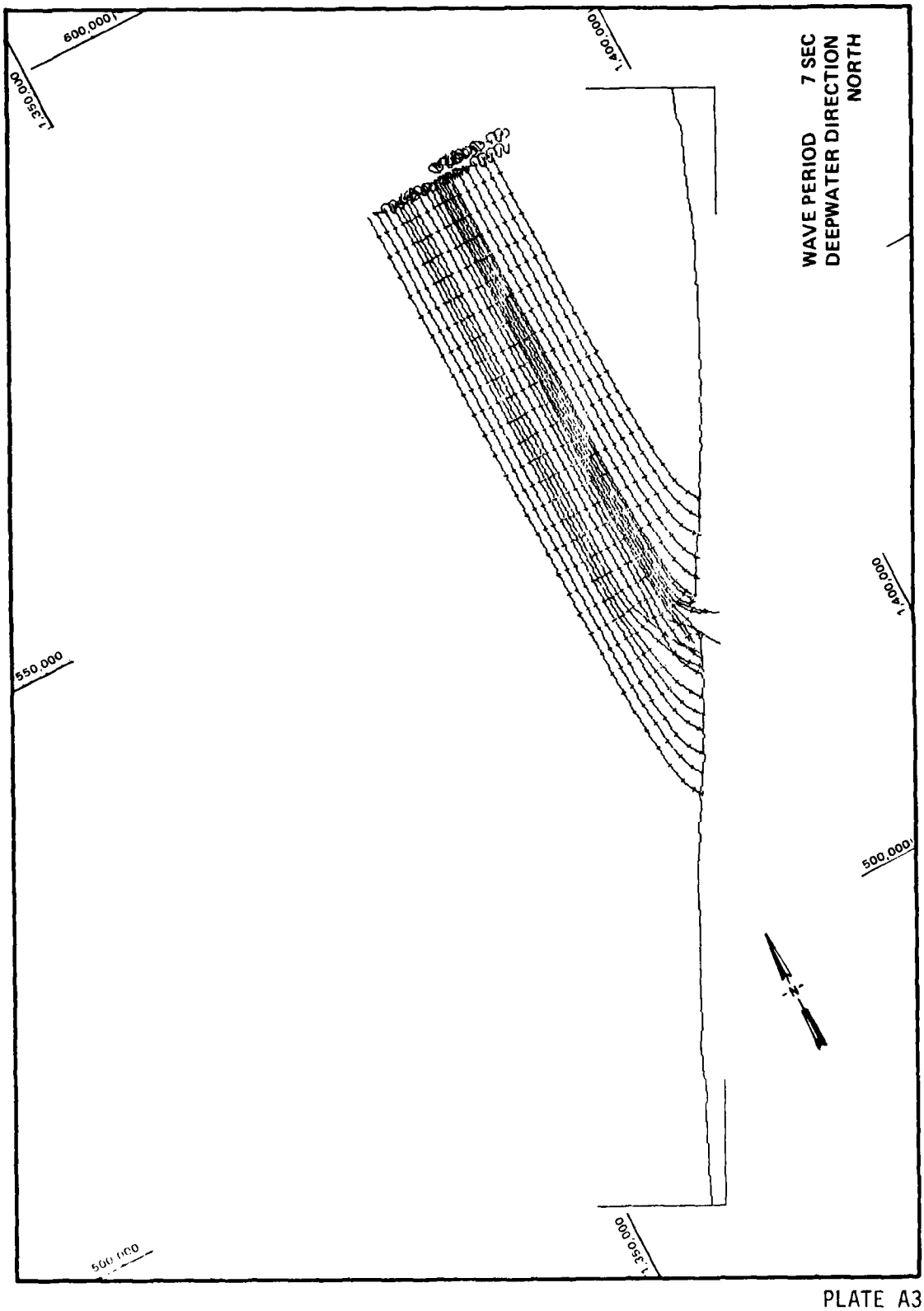

WAVE PERIOD 9 SEC
DEEPWATER DIRECTION NORTH
600,000
1,350,000
1,400,000
550,000
500,000
N

PLATE A4


WAVE PERIOD 7 SEC
DEEPWATER DIRECTION NORTH
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1,350,000
1,400,000
550,000
1,400,000
500,000
1,350,000
500,000

PLATE A3

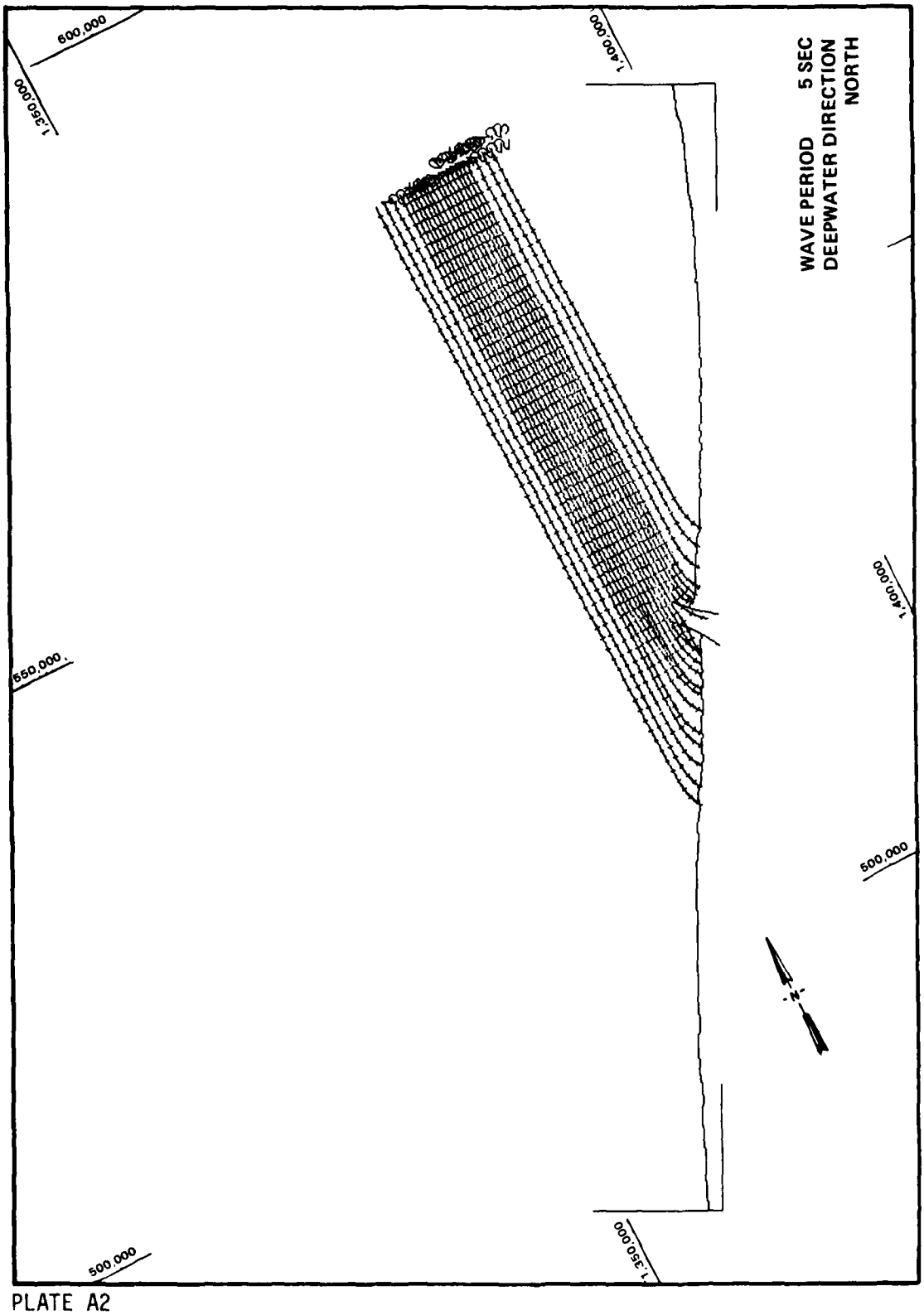
WAVE PERIOD 5 SEC
DEEPWATER DIRECTION NORTH
600,000
1,400,000
1,350,000
550,000
500,000
N

PLATE A2

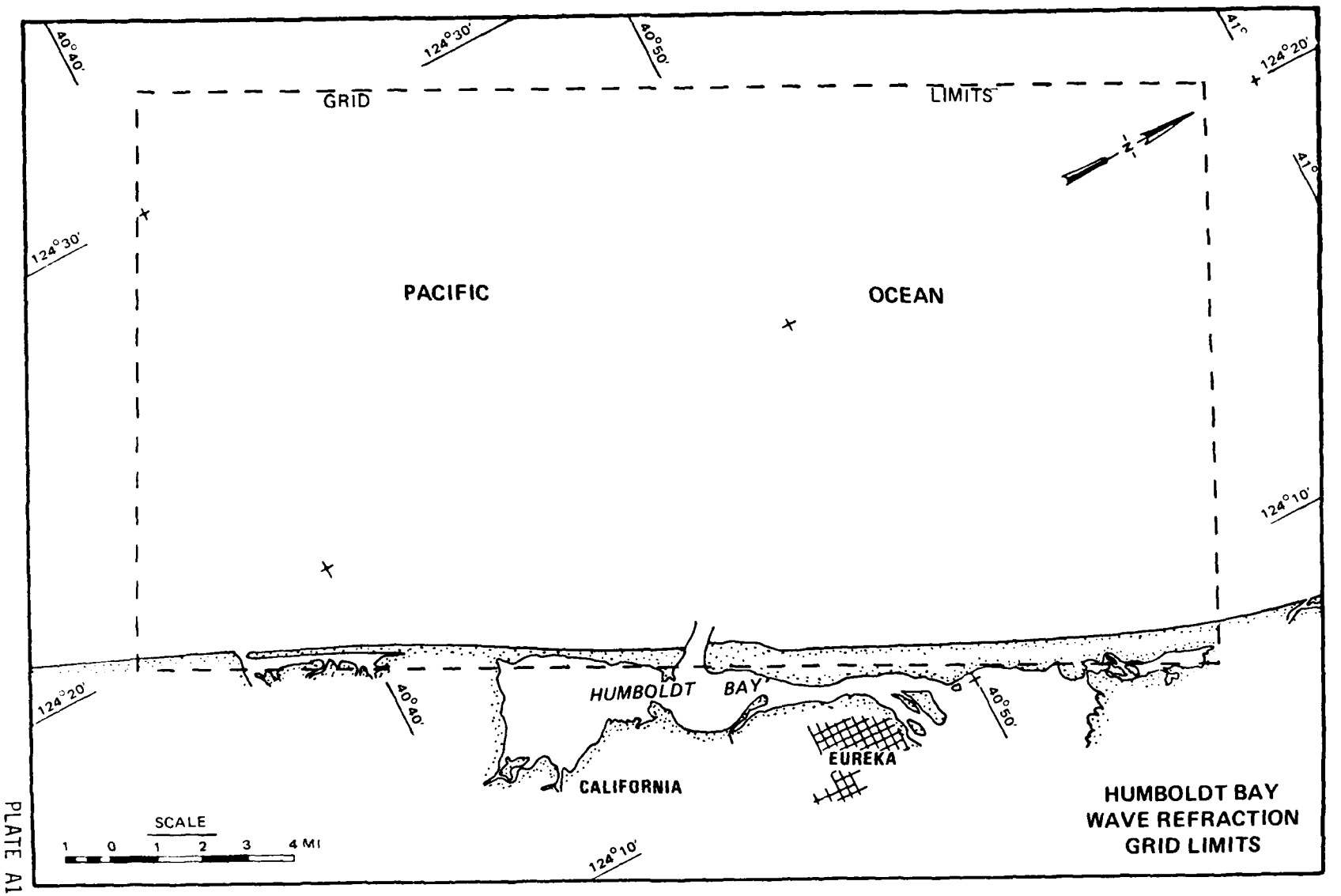
GRID
LIMITS
PACIFIC
OCEAN
HUMBOLDT BAY
EUREKA
CALIFORNIA
40°40'
40°50'
124°30'
124°20'
124°10'
SCALE
1 0 1 2 3 4 MI
HUMBOLDT BAY
WAVE REFRACTION
GRID LIMITS

PLATE A1

Table A1

Summary of Refraction and Shoaling Analysis for Humboldt Bay

Deepwater Direction, Azimuth, deg	Wave Period sec	Shallow-Water Direction, Azimuth, deg	Refraction* Coefficient	Shoaling** Coefficient	Wave-Height Adjustment Factor
North (360)	5	359	1.00	1.00	1.00
	7	353	0.99	0.99	0.98
	9	351	0.87	0.94	0.82
	11	346	0.85	0.92	0.78
	13	344	0.83	0.92	0.76
	15	341	0.86	0.93	0.80
	17	340	0.84	0.96	0.81
	19	335	0.85	0.99	0.84
Northwest (315)	5	315	1.02	1.00	1.02
	7	311	1.01	0.99	1.00
	9	308	1.02	0.94	0.96
	11	307	1.04	0.92	0.96
	13	307	1.02	0.92	0.94
	15	307	1.05	0.93	0.98
	17	305	1.02	0.96	0.98
	19	302	1.02	0.99	1.01
West (270)	5	270	1.00	1.00	1.00
	7	271	1.00	0.99	0.99
	9	274	0.98	0.94	0.92
	11	277	0.88	0.92	0.81
	13	280	0.81	0.92	0.75
	15	280	0.88	0.93	0.82
	17	280	0.98	0.96	0.94
	19	282	0.96	0.99	0.95
Southwest (225)	5	226	0.99	1.00	0.99
	7	238	0.93	0.99	0.92
	9	248	0.83	0.94	0.78
	11	255	0.82	0.92	0.75
	13	261	0.85	0.92	0.78
	15	265	1.01	0.93	0.94
	17	267	0.93	0.96	0.89
	19	271	0.75	0.99	0.74

* At approximate location of wave generator in model.

** At 117-ft depth (110-ft pit elevation with 7-ft tide conditions superimposed).

rectangular depth grid 24.8 miles by 12.6 miles which paralleled the shoreline in the vicinity of the project area. Limits of the depth grid used are shown in Plate A1. The grid spacing was 600 ft and depths were taken from the latest hydrographic survey charts. Storm conditions were represented by superimposing a water level of 7.0 ft on the depth grid.

4. Wave orthogonals were produced for 5-, 7-, 9-, 11-, 13-, 15-, 17-, and 19-sec waves from north, northwest, west, and southwest. The plots obtained are shown in Plates A2-A33.

5. Refraction coefficients and shallow-water orthogonal directions obtained for the various wave periods from the four deepwater wave directions are presented in Table A1. These values represent an average of the orthogonals in the immediate vicinity of the harbor site (approximately the location of the wave generator in the model). Shoaling coefficients of 1.00, 0.99, 0.94, 0.92, 0.92, 0.93, 0.96, and 0.99 for 5-, 7-, 9-, 11-, 13-, 15-, 17-, and 19-sec wave periods, respectively, were computed for a 117-ft water depth corresponding to the simulated depth at the model wave generator. The wave-height adjustment factor is obtained by multiplying K_r times K_s and can be applied to any deepwater wave height to obtain the corresponding shallow-water value.

6. Based on the refracted directions secured at the model contours for each wave period, four wave generator positions were available for model testing representing the various deepwater directions. The following tabulation shows the deepwater directions and the corresponding shallow-water test directions.

Deepwater Direction, Azimuth, deg	Corresponding Shallow-Water Test Direction, Azimuth, deg
North, 360	346
Northwest, 315	308
West, 270	277
Southwest, 225	254

The shallow-water wave directions were taken to be the average directions of the refracted waves for the significant wave periods noted from each deepwater direction.

APPENDIX A: WAVE REFRACTION ANALYSIS FOR HUMBOLDT BAY

1. Prior to the hydraulic model investigation of Humboldt Bay, a wave refraction analysis was conducted at the US Army Engineer Waterways Experiment Station (WES) to determine the shallow-water wave height and the refracted wave direction at the model wave generator pit for representative wave periods from the critical directions of deepwater wave approach. This analysis was conducted using a linear wave refraction theory originally developed at Stanford University by Dobson (1967)* and modified by WES in 1971. All computations and plotting were done using an Electronic Associates, Inc. (EAI) Pacer 100 minicomputer and Versatec electrostatic plotter at WES.

2. In this analysis, the effects of both reflection and diffraction are neglected. These assumptions are valid except in convergence areas where caustics occur and linear theory does not apply. Therefore the major assumption in determining the wave height at any point on a wave orthogonal, within the limits of the linear theory, is that no energy is transmitted perpendicular to the orthogonal along the wave crest, in which case the height at any given point is given by

$$H = H_o K_s K_r$$

where

H_o = wave height in deep water
K_s = shoaling coefficient
K_r = refraction coefficient

This assumption has been shown to be reasonable for mild slopes which induce only gradual bending of the orthogonals. For areas of extreme refraction, failure to consider the flow of energy along the wave crests can lead to significant errors in the computed wave height. Since previous research at WES by Whalin (1971, 1972) has shown that wave energy will tend to flow along the wave crests in areas of energy concentration, a maximum refraction coefficient of 1.4 and a minimum refraction coefficient of 0.45 were selected as being reasonable values.

3. Refraction diagrams for Humboldt Bay were produced from a

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* See References at the end of main text.

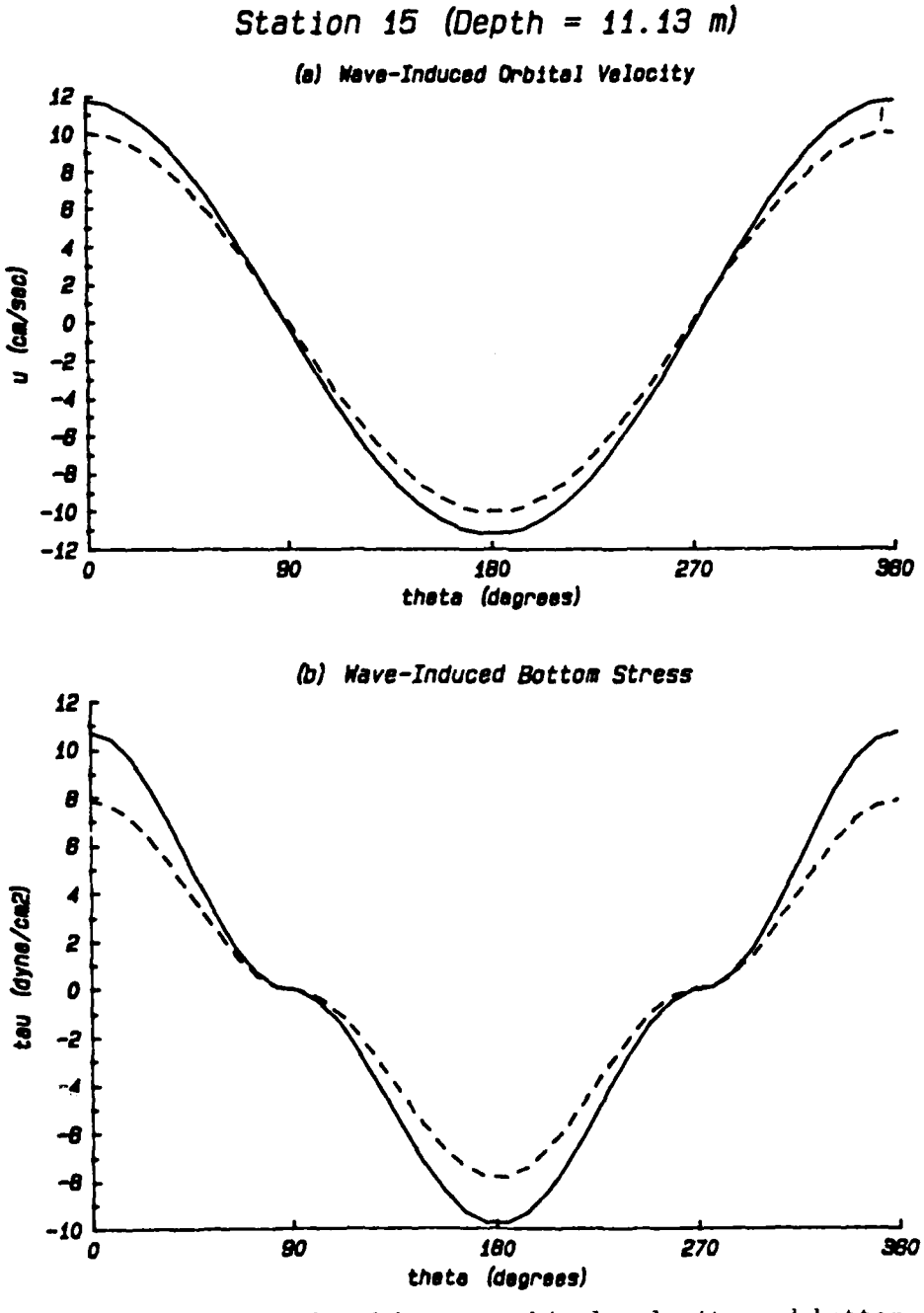


Plate 78. Wave-induced bottom orbital velocity and bottom stress at sta 15; 11-sec, 10-ft waves from the northwest; maximum ebb; +3.7 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

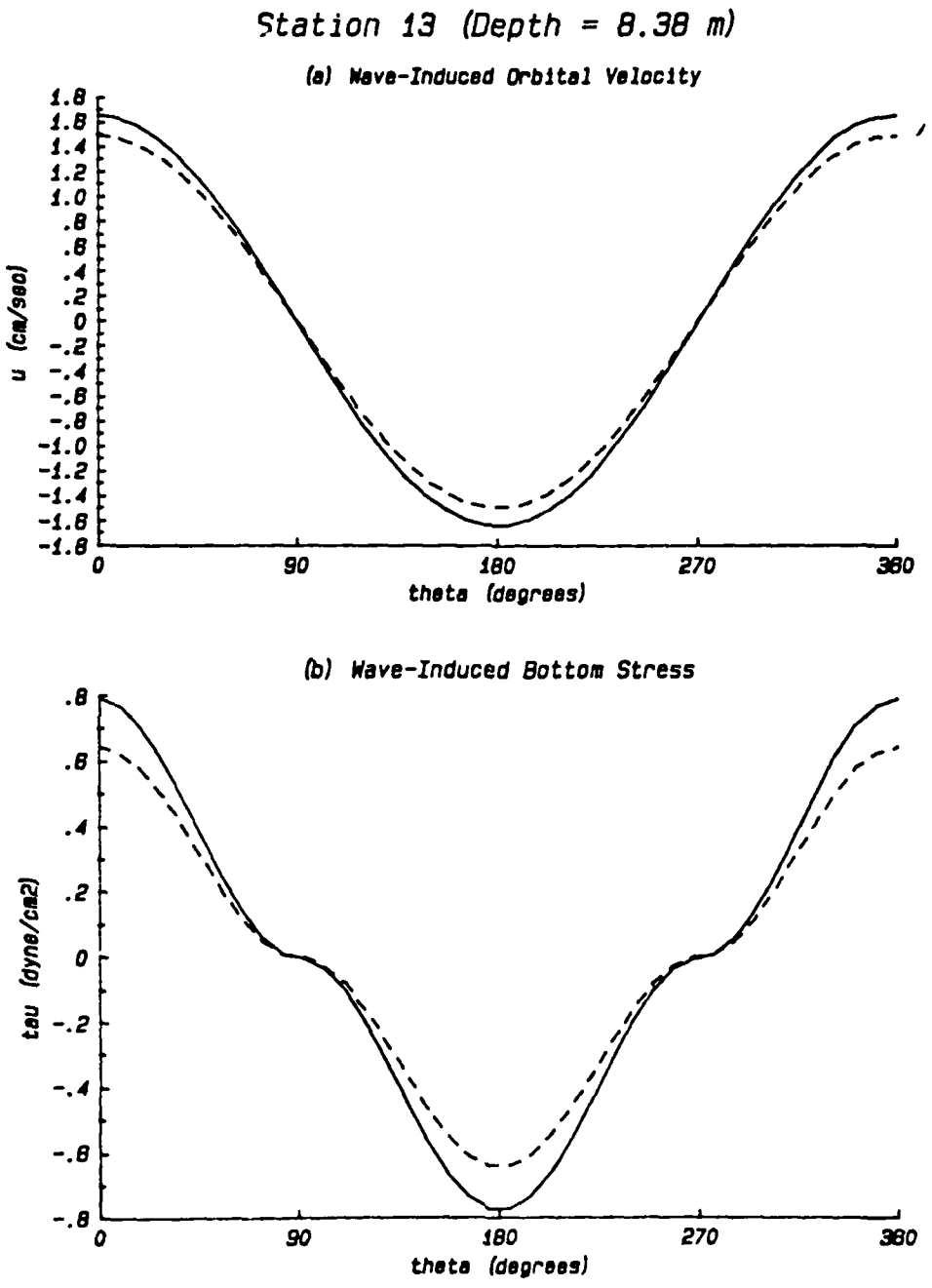


Plate 77. Wave-induced bottom orbital velocity and bottom stress at sta 13; 11-sec, 10-ft waves from the northwest; maximum ebb; +3.7 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

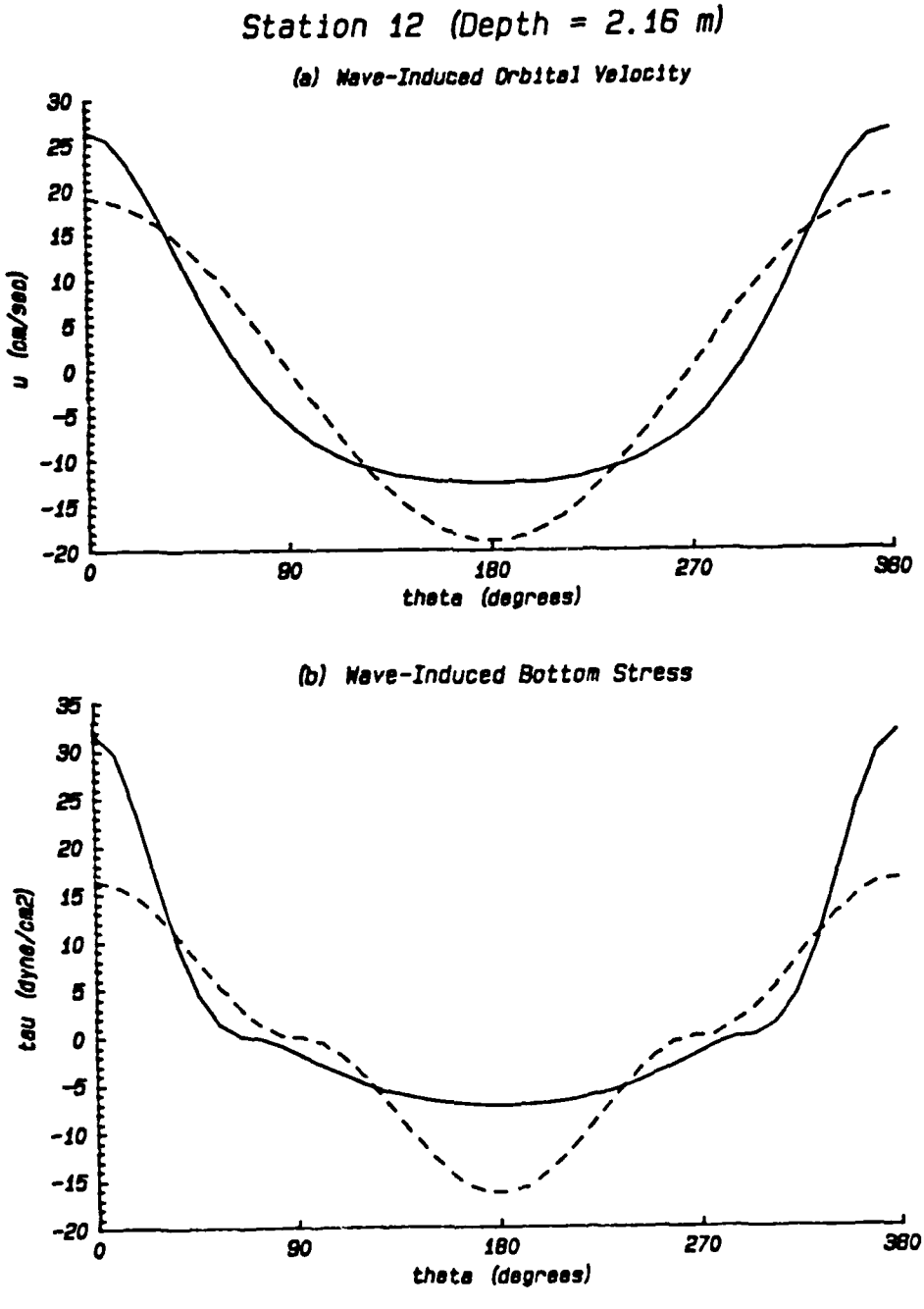


Plate 76. Wave-induced bottom orbital velocity and bottom stress at sta 12; 11-sec, 10-ft waves from the northwest; maximum ebb; +3.7 ft swl; cnoidal wave theory (solid lines) and linear wave theory (dashed lines)

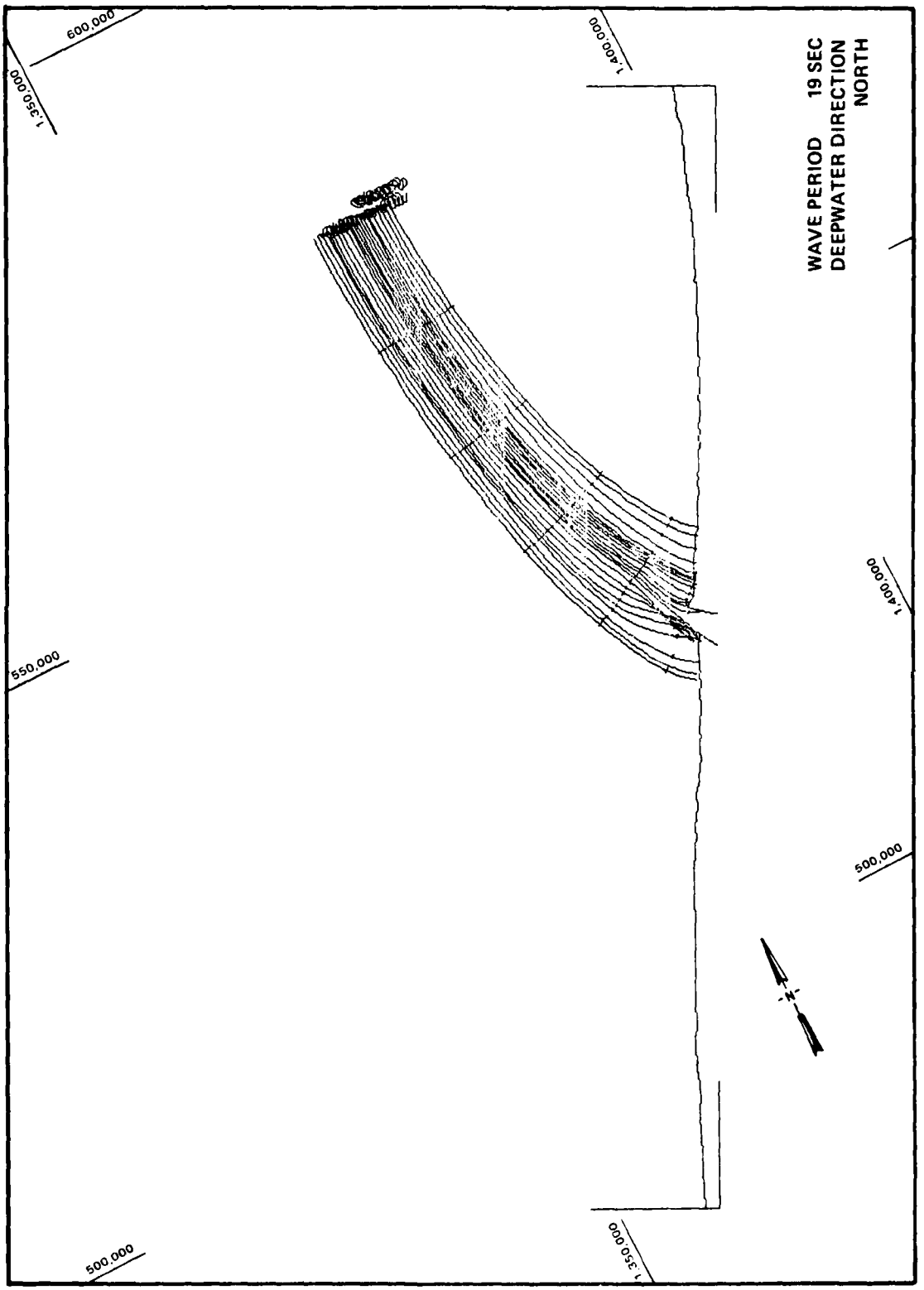
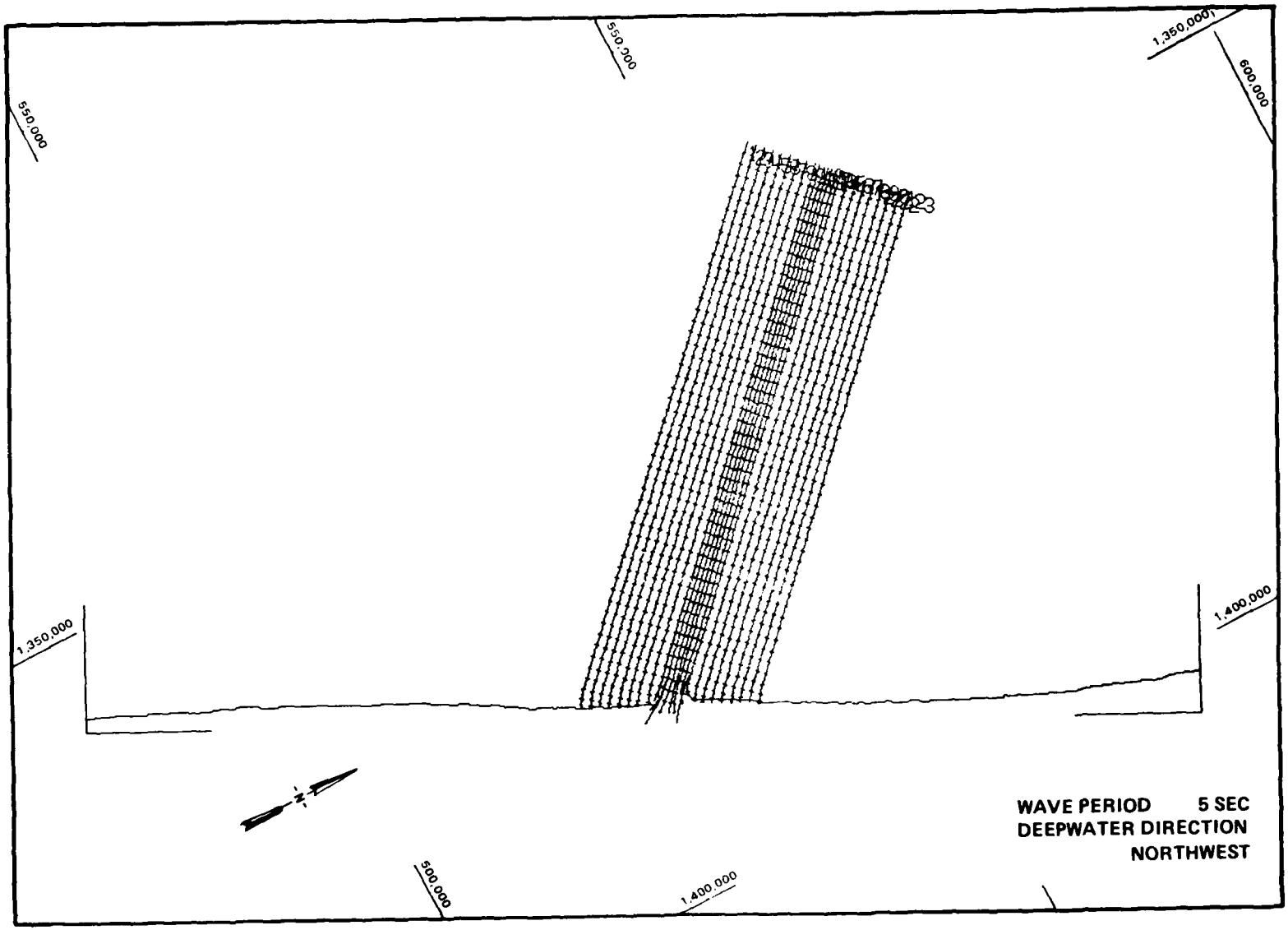

WAVE PERIOD 19 SEC
DEEPWATER DIRECTION NORTH
600,000
1,400,000
1,350,000
550,000
1,400,000
500,000
500,000
1,350,000

PLATE A9

PLATE A10


550,200
1,350,000
600,000
550,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 5 SEC
DEEPWATER DIRECTION
NORTHWEST

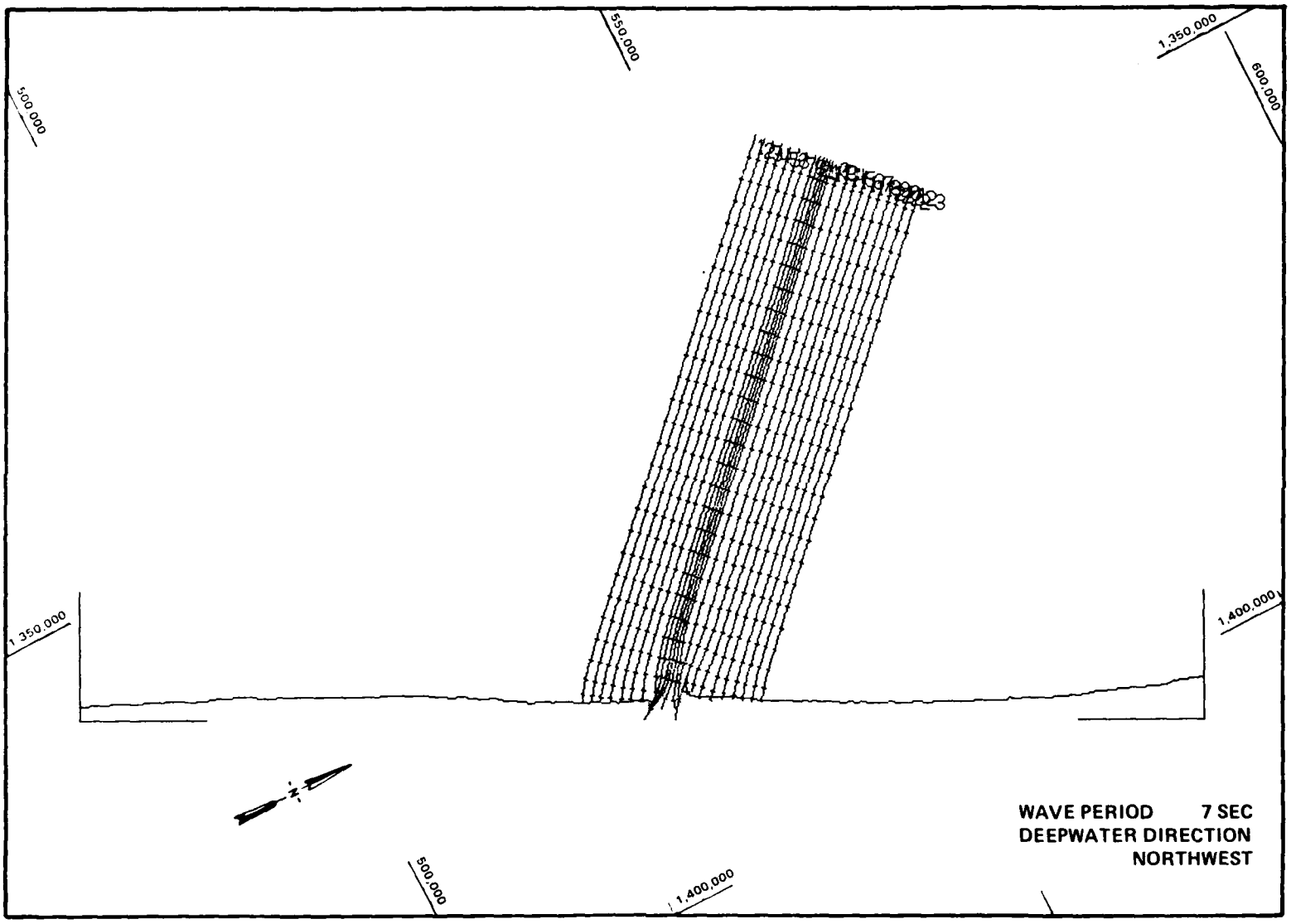

550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
N
500,000
1,400,000
WAVE PERIOD 7 SEC
DEEPWATER DIRECTION
NORTHWEST

PLATE A11

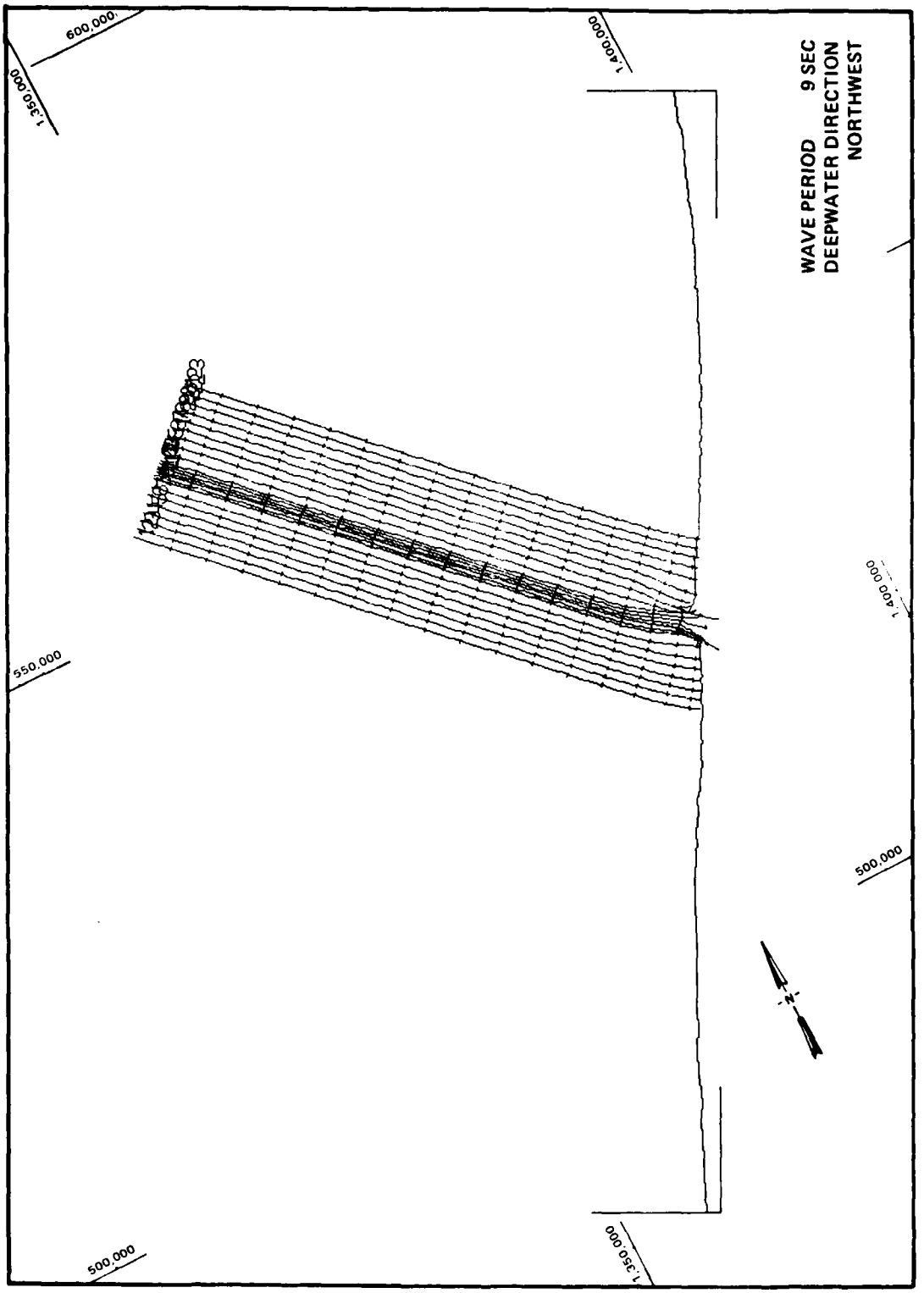

WAVE PERIOD 9 SEC
DEEPWATER DIRECTION NORTHWEST
600,000
1,400,000
1,350,000
550,000
500,000
N

PLATE A12

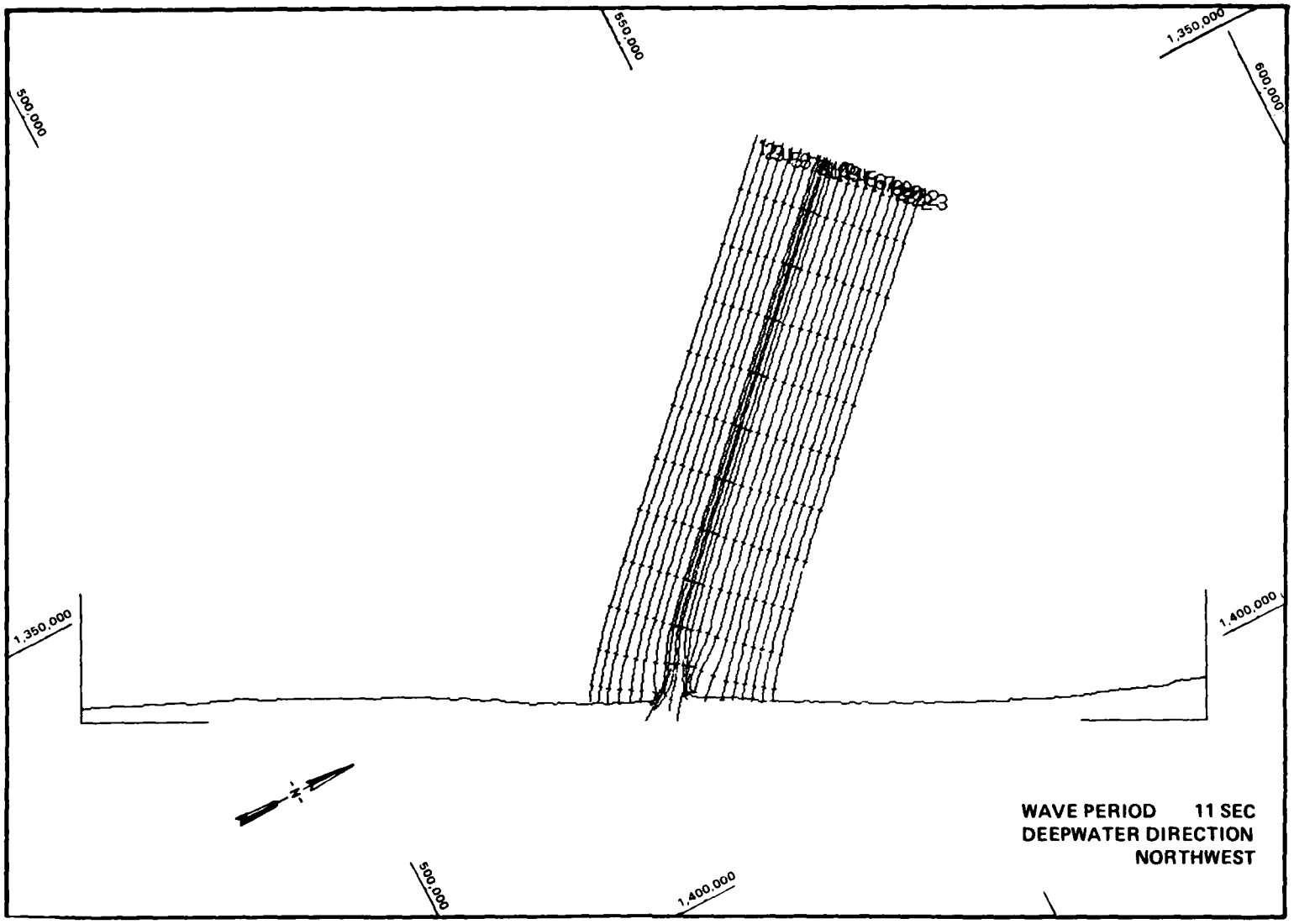

550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 11 SEC
DEEPWATER DIRECTION
NORTHWEST

PLATE A13

WAVE PERIOD 13 SEC
DEEPWATER DIRECTION NORTHWEST
600,000
1,350,000
1,400,000
550,000
1,400,000
500,000
500,000
1,350,000

PLATE A14

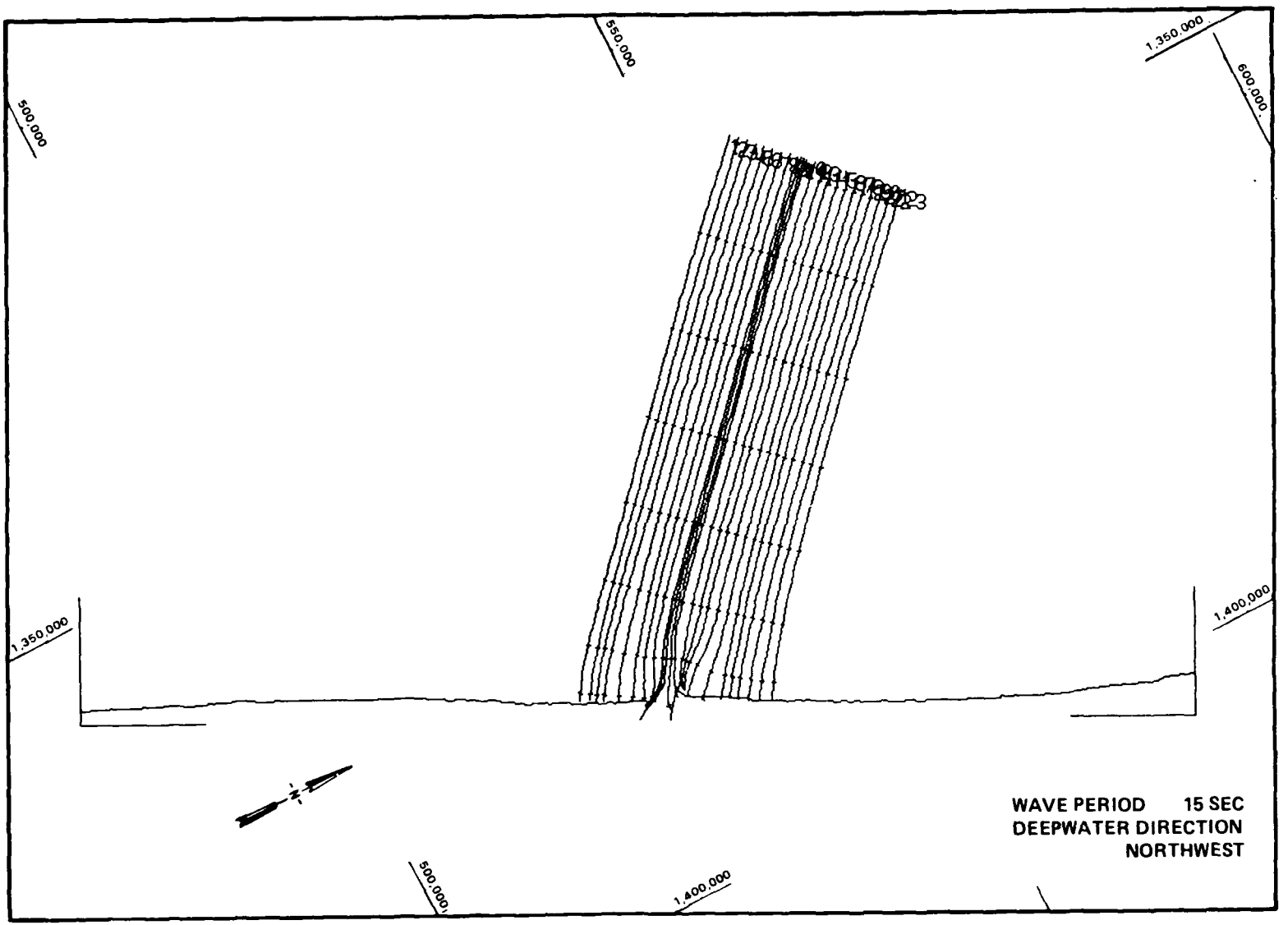
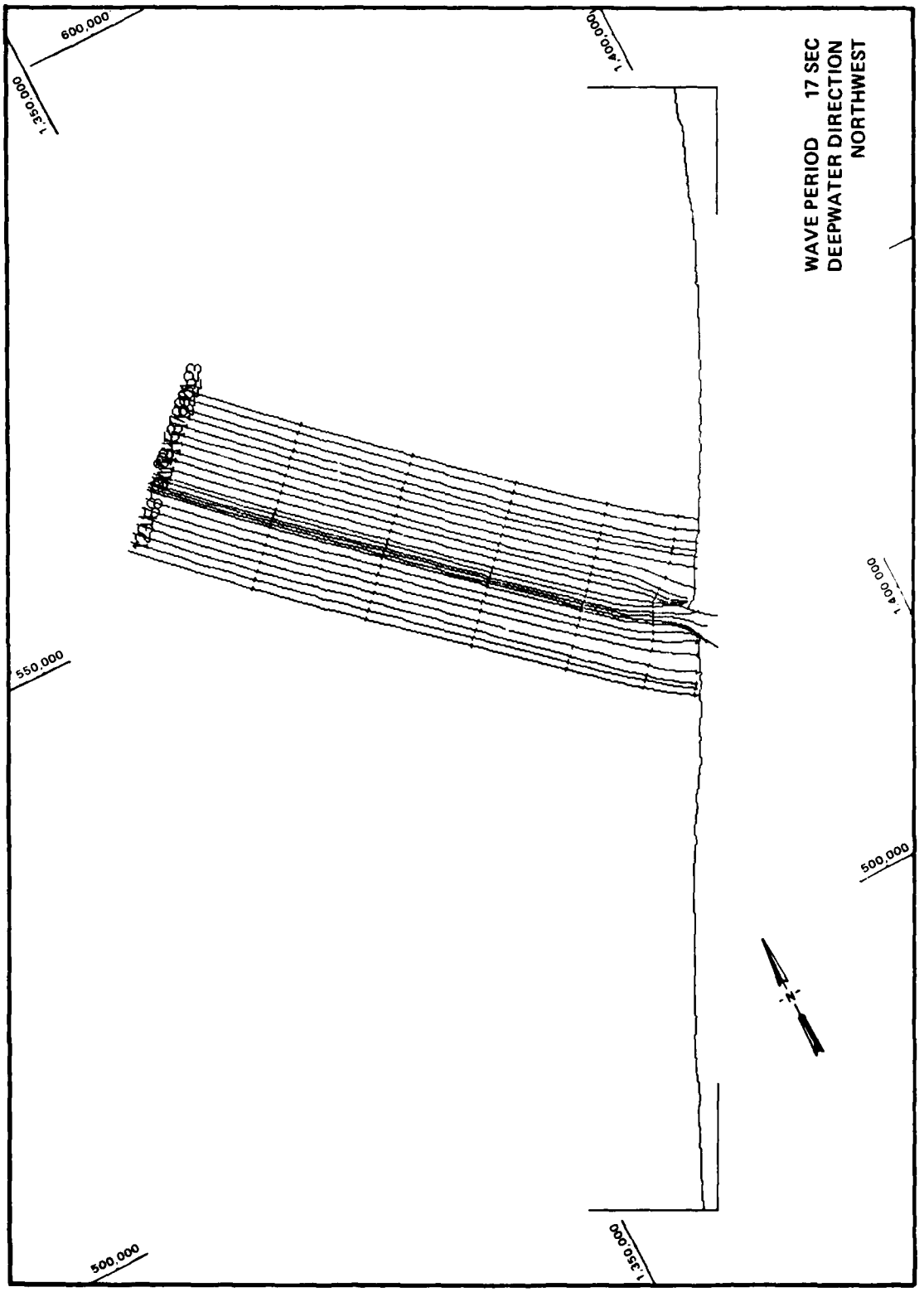

550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 15 SEC
DEEPWATER DIRECTION
NORTHWEST

PLATE A15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DEEPWATER DIRECTION NORTHWEST
600,000
1,400,000
1,350,000
550,000
500,000
N

PLATE A16

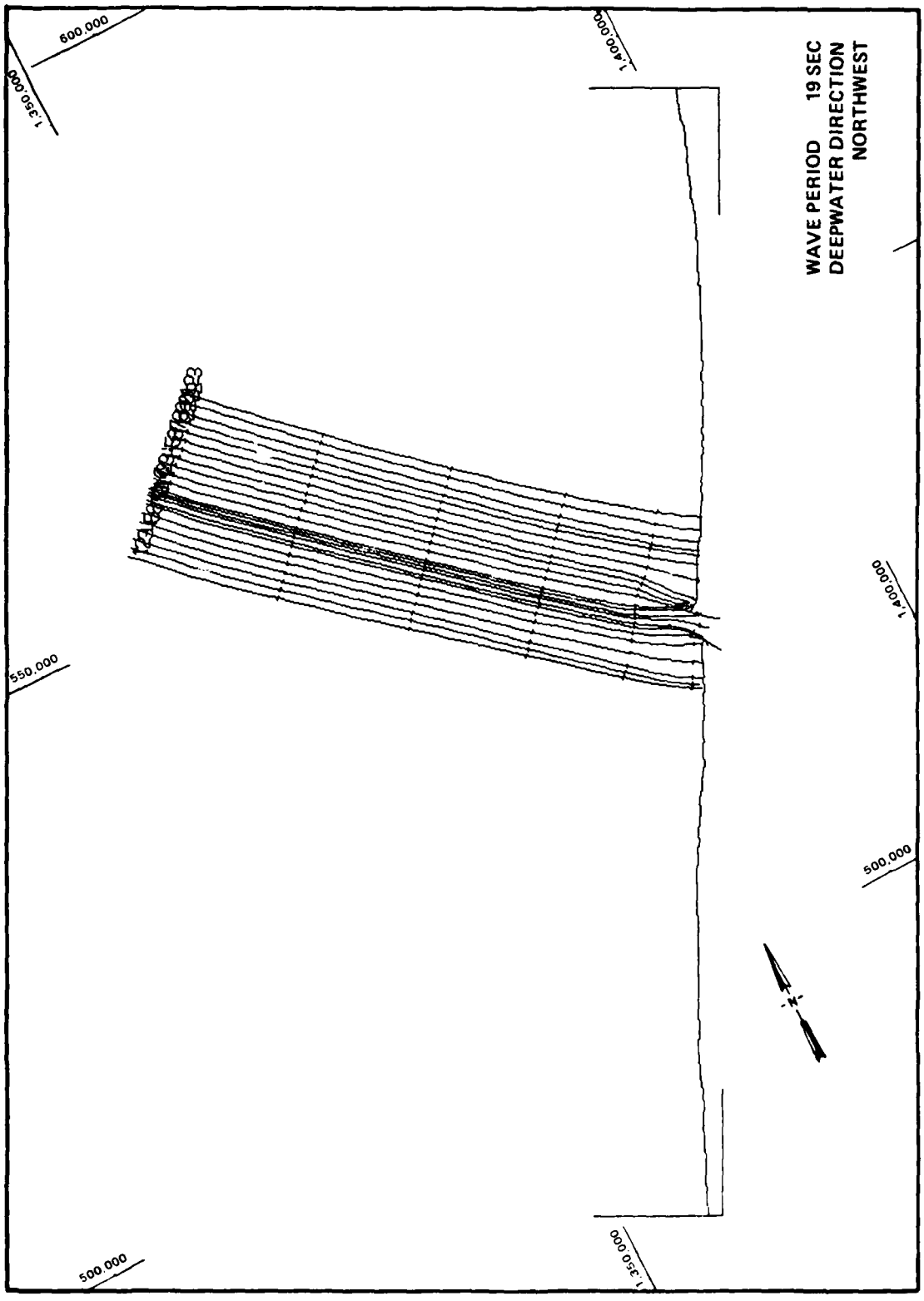

WAVE PERIOD 19 SEC
DEEPWATER DIRECTION
NORTHWEST
600,000
1,400,000
1,350,000
550,000
500,000
N

PLATE A17

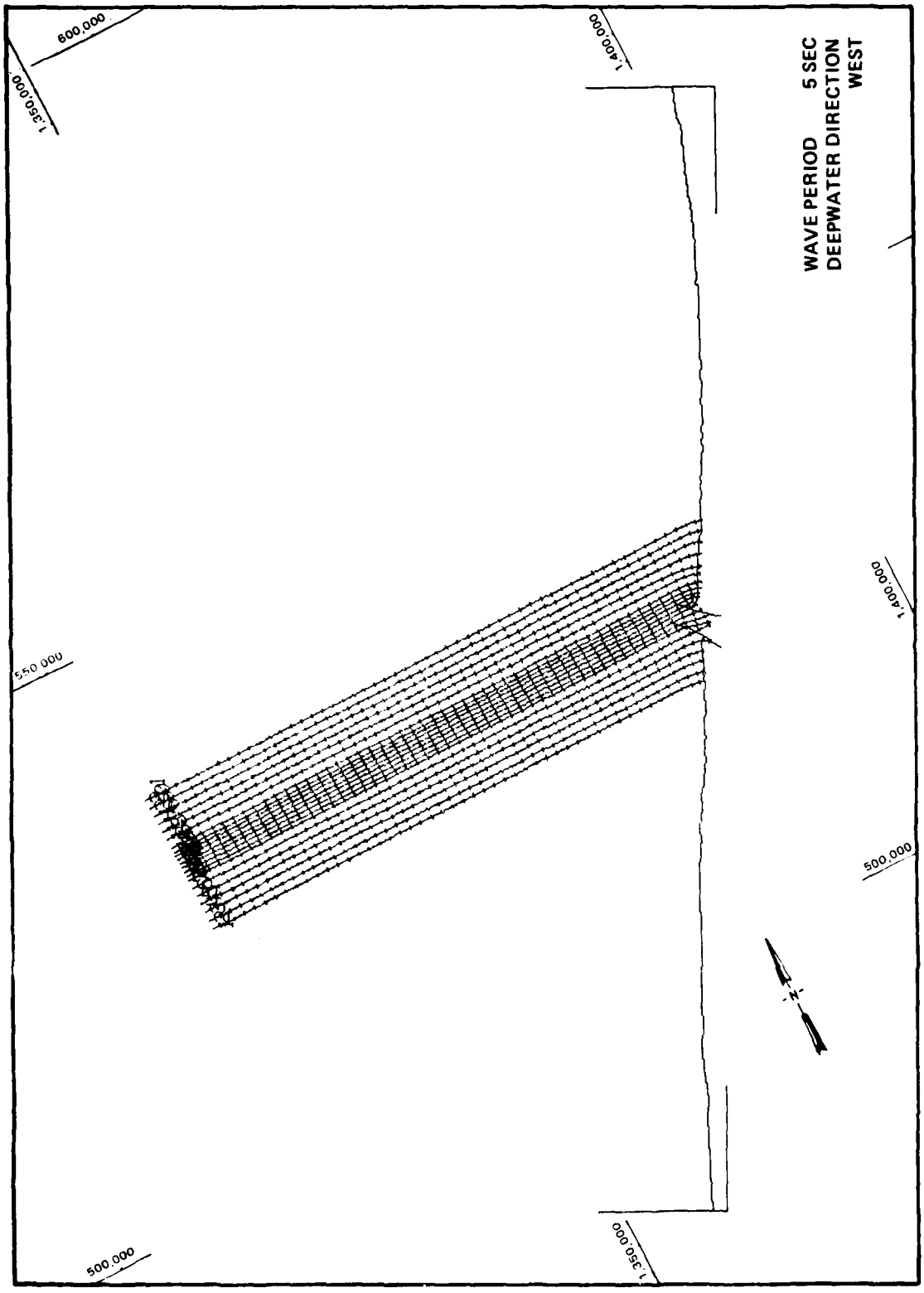

WAVE PERIOD 5 SEC
DEEPWATER DIRECTION WEST
600,000
1,400,000
1,350,000
550,000
1,400,000
500,000
500,000
1,350,000
N

PLATE A18

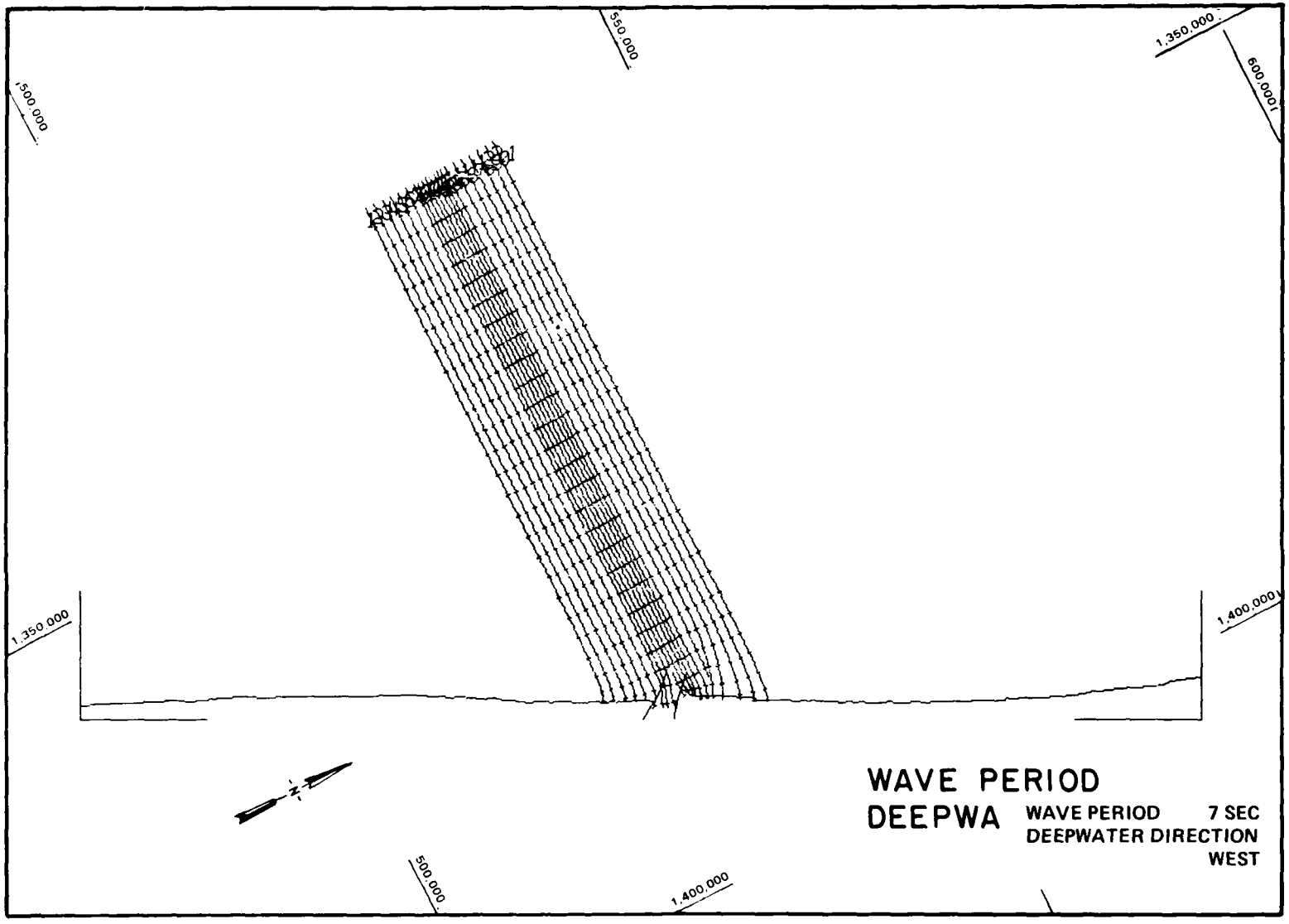

550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD
DEEPWA
WAVE PERIOD 7 SEC
DEEPWATER DIRECTION
WEST

PLATE A19

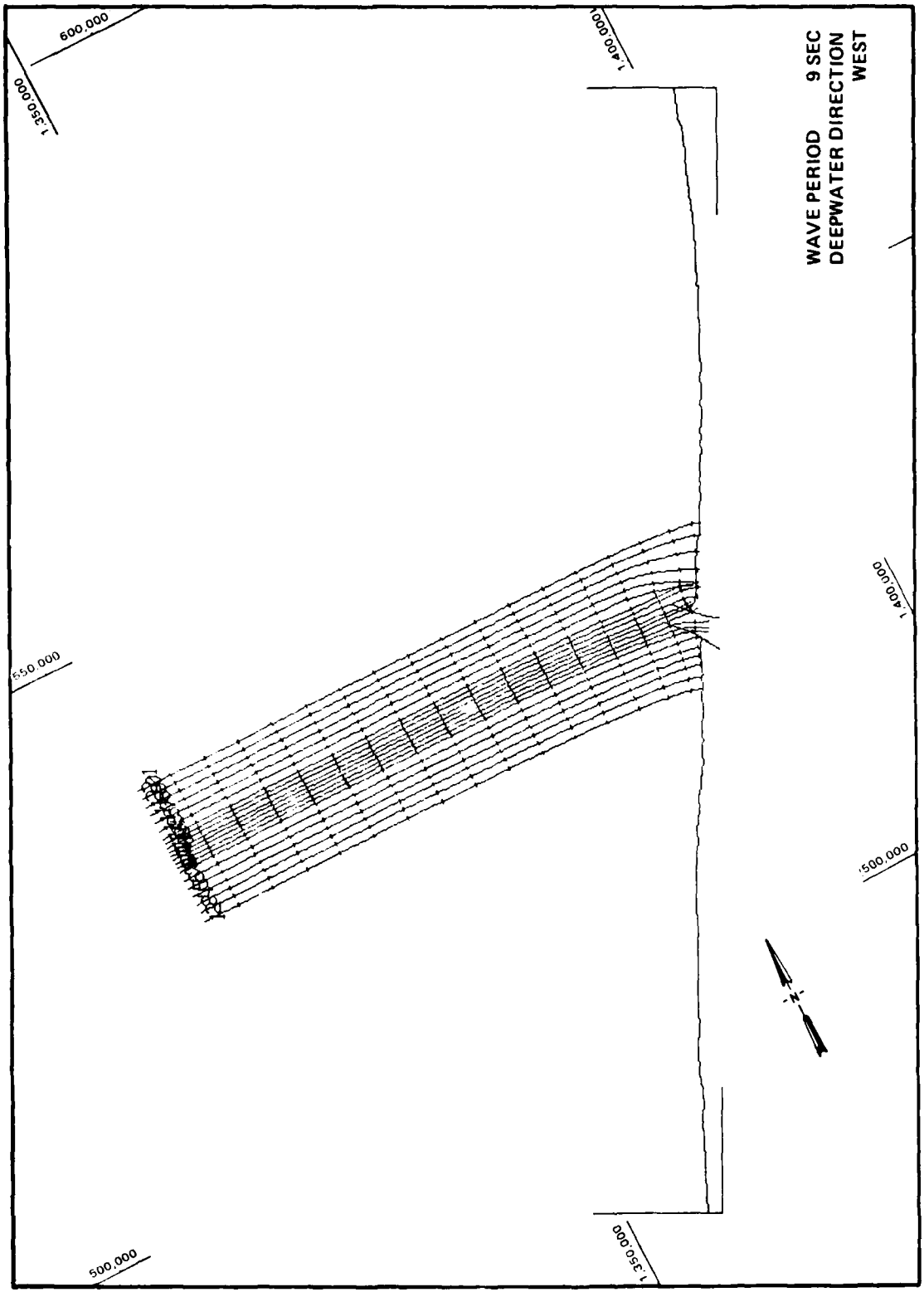

WAVE PERIOD 9 SEC
DEEPWATER DIRECTION WEST
600,000
1,350,000
1,400,000
650,000
500,000
N

PLATE A20

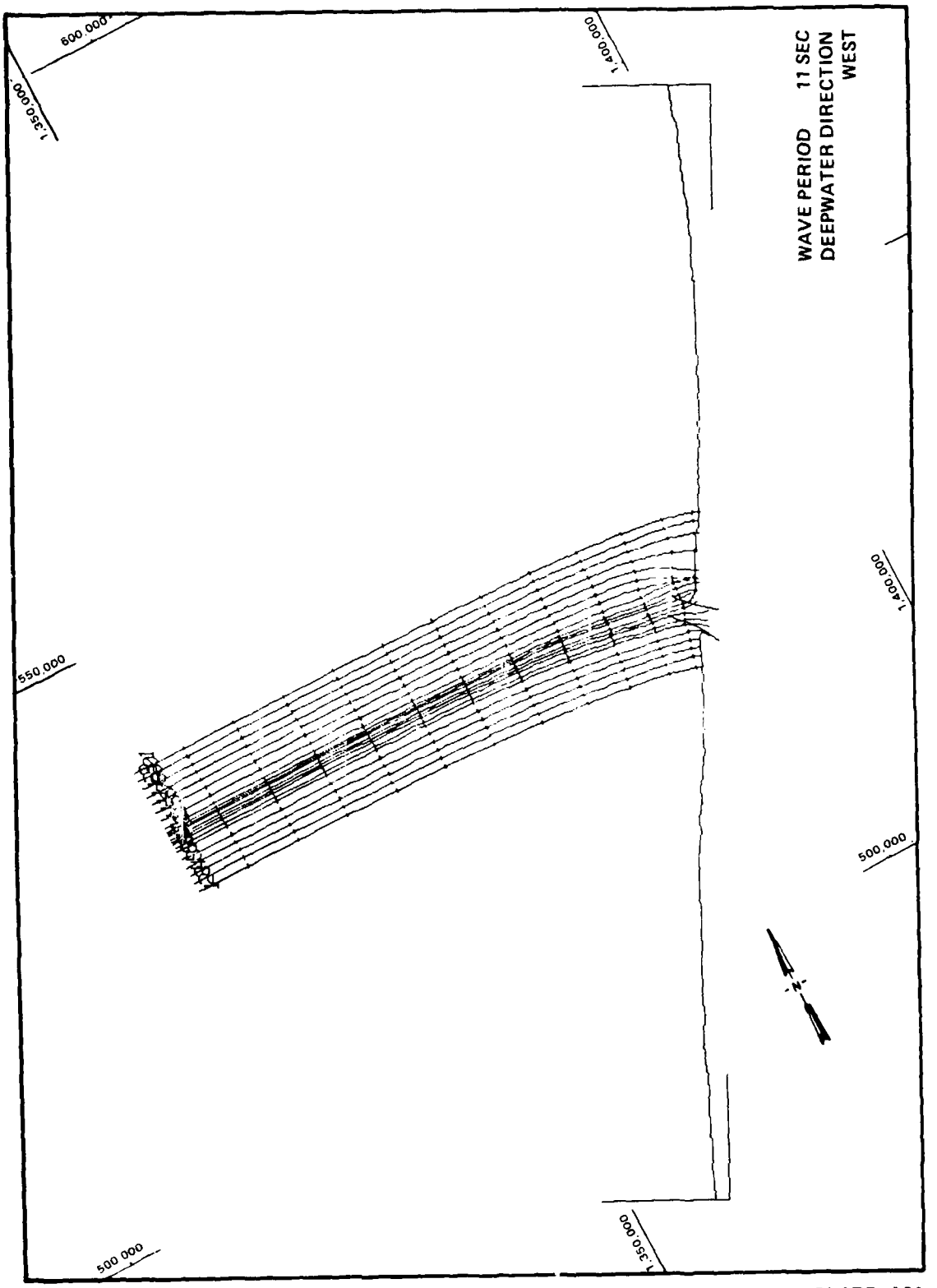
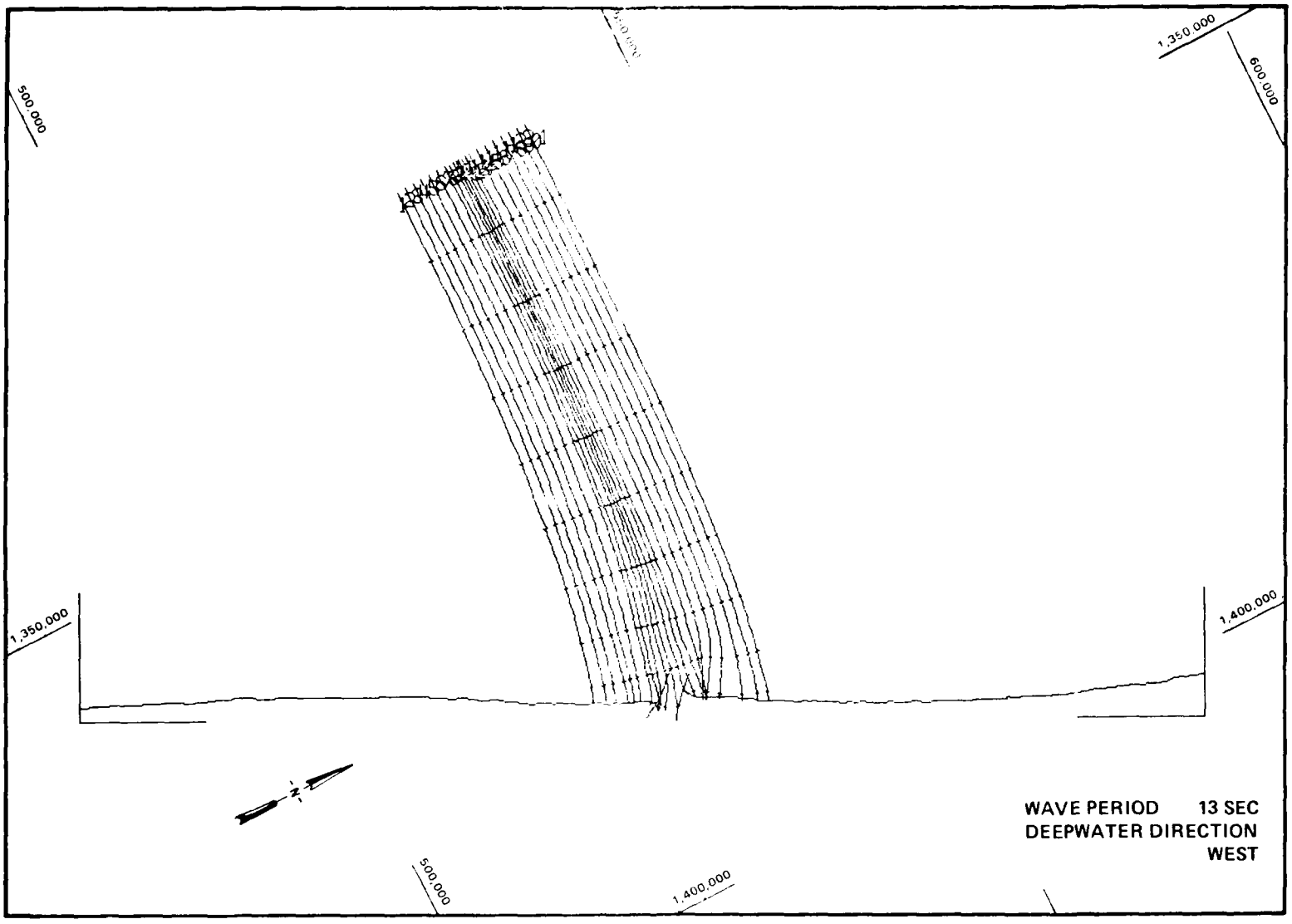
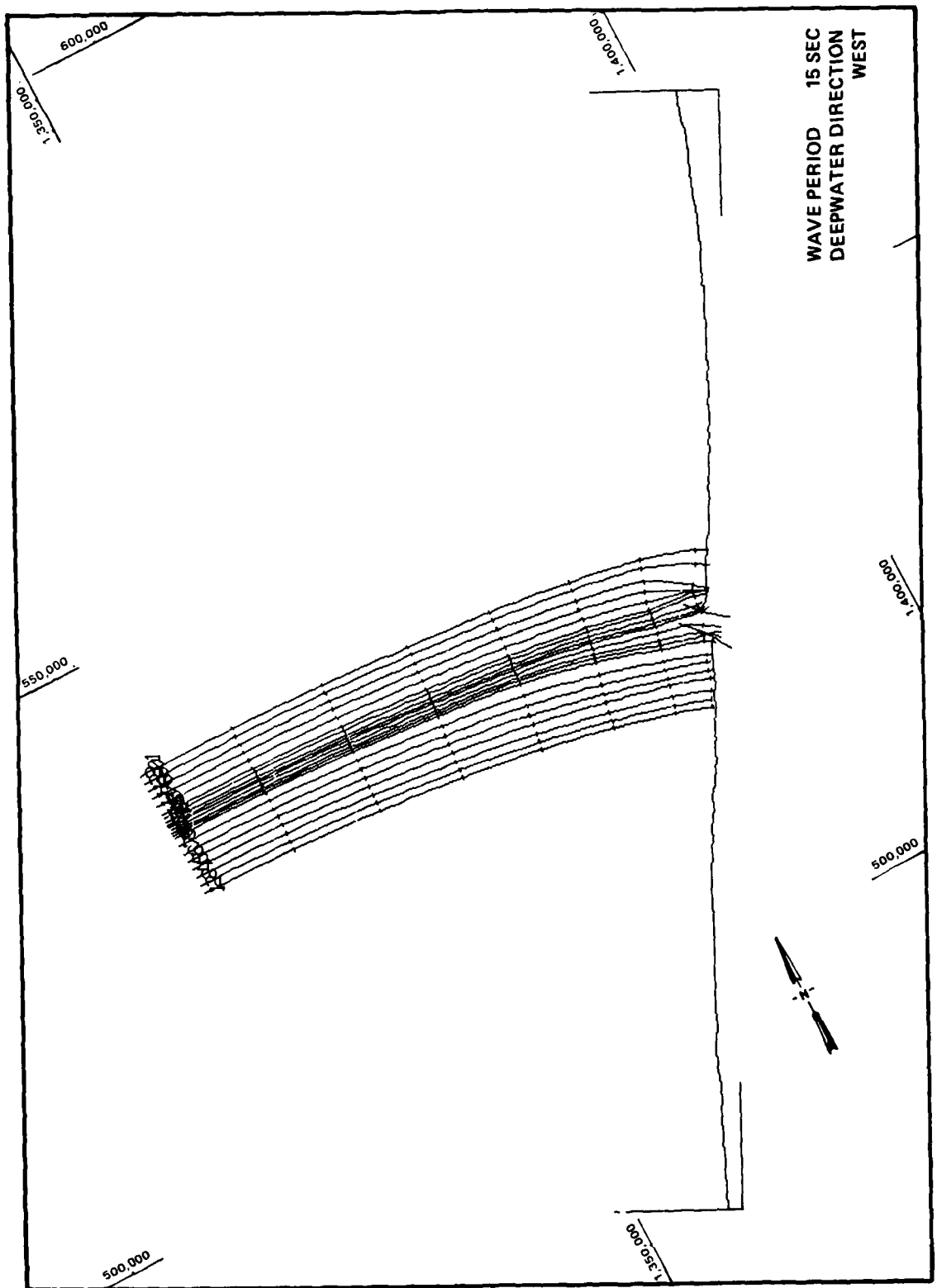

WAVE PERIOD 11 SEC
DEEPWATER DIRECTION WEST
600,000
1,400,000
1,350,000
550,000
500,000
N

PLATE A21

PLATE A22


500,000
1,350,000
600,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 13 SEC
DEEPWATER DIRECTION
WEST


WAVE PERIOD 15 SEC
DEEPWATER DIRECTION WEST
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1,400,000
1,350,000
550,000
1,400,000
500,000
1,350,000
500,000

PLATE A23

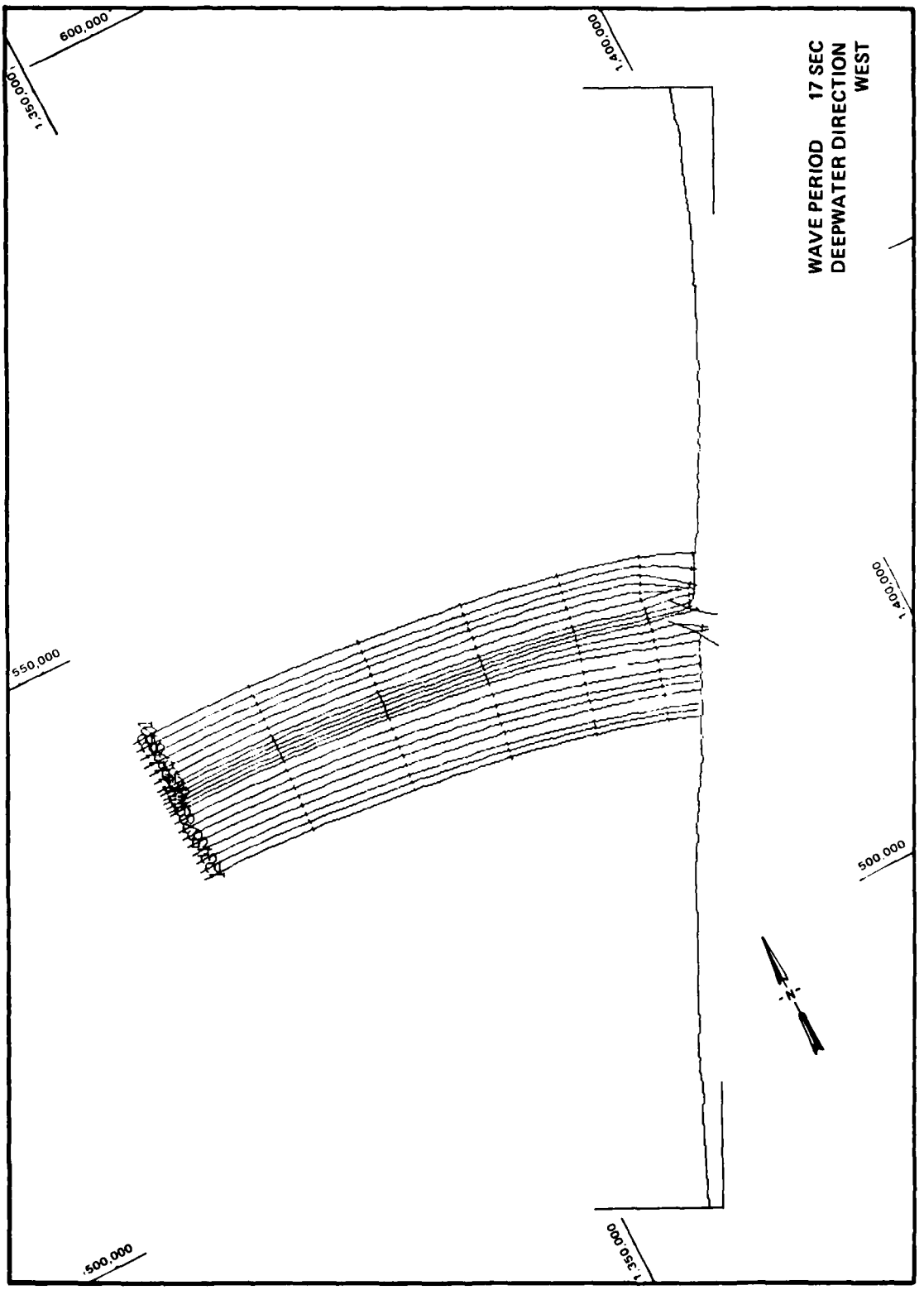
600,000
1,350,000
1,400,000
WAVE PERIOD 17 SEC
DEEPWATER DIRECTION WEST
550,000
1,400,000
500,000
N
500,000
1,350,000

PLATE A24

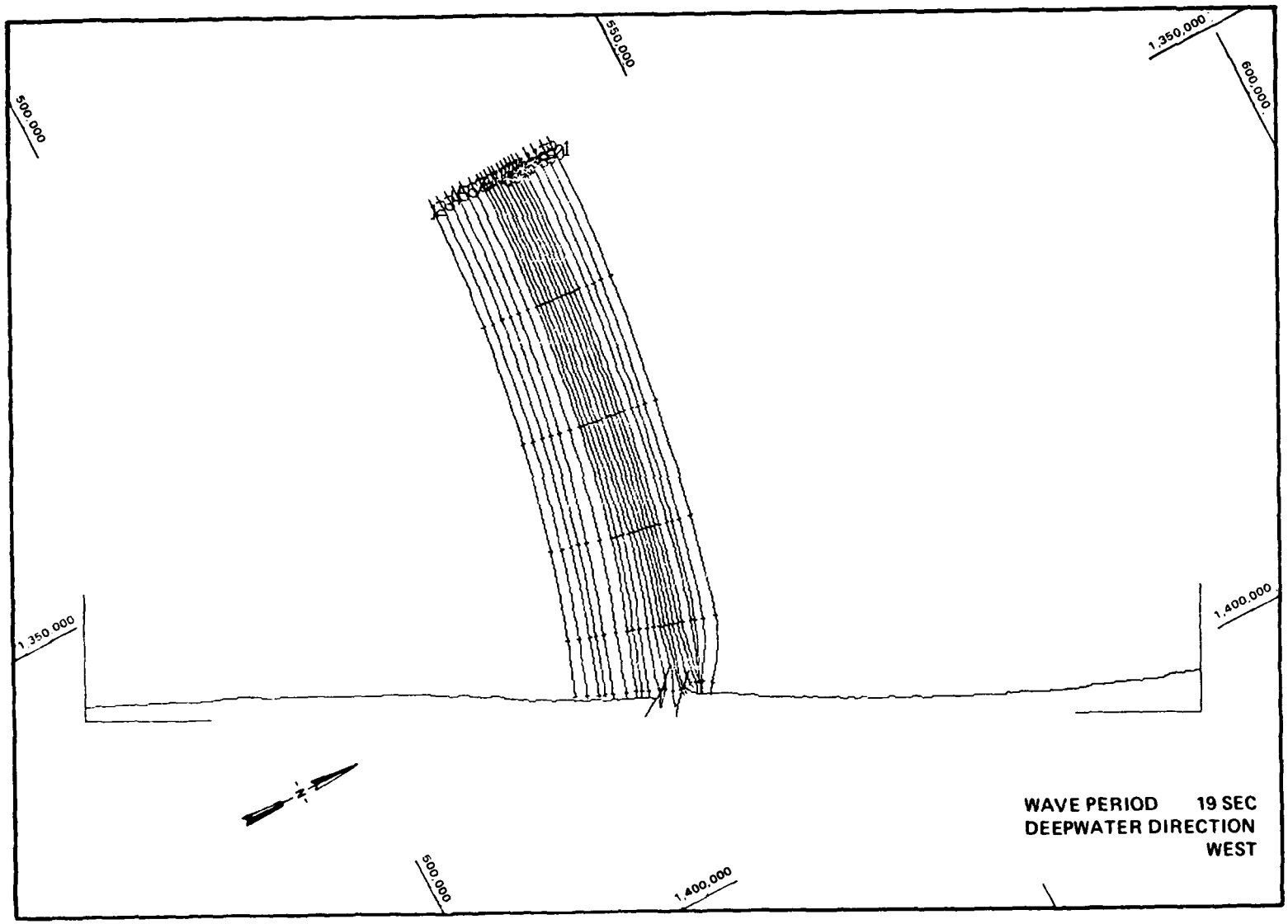
550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
500,000
1,400,000
WAVE PERIOD 19 SEC
DEEPWATER DIRECTION
WEST

PLATE A25

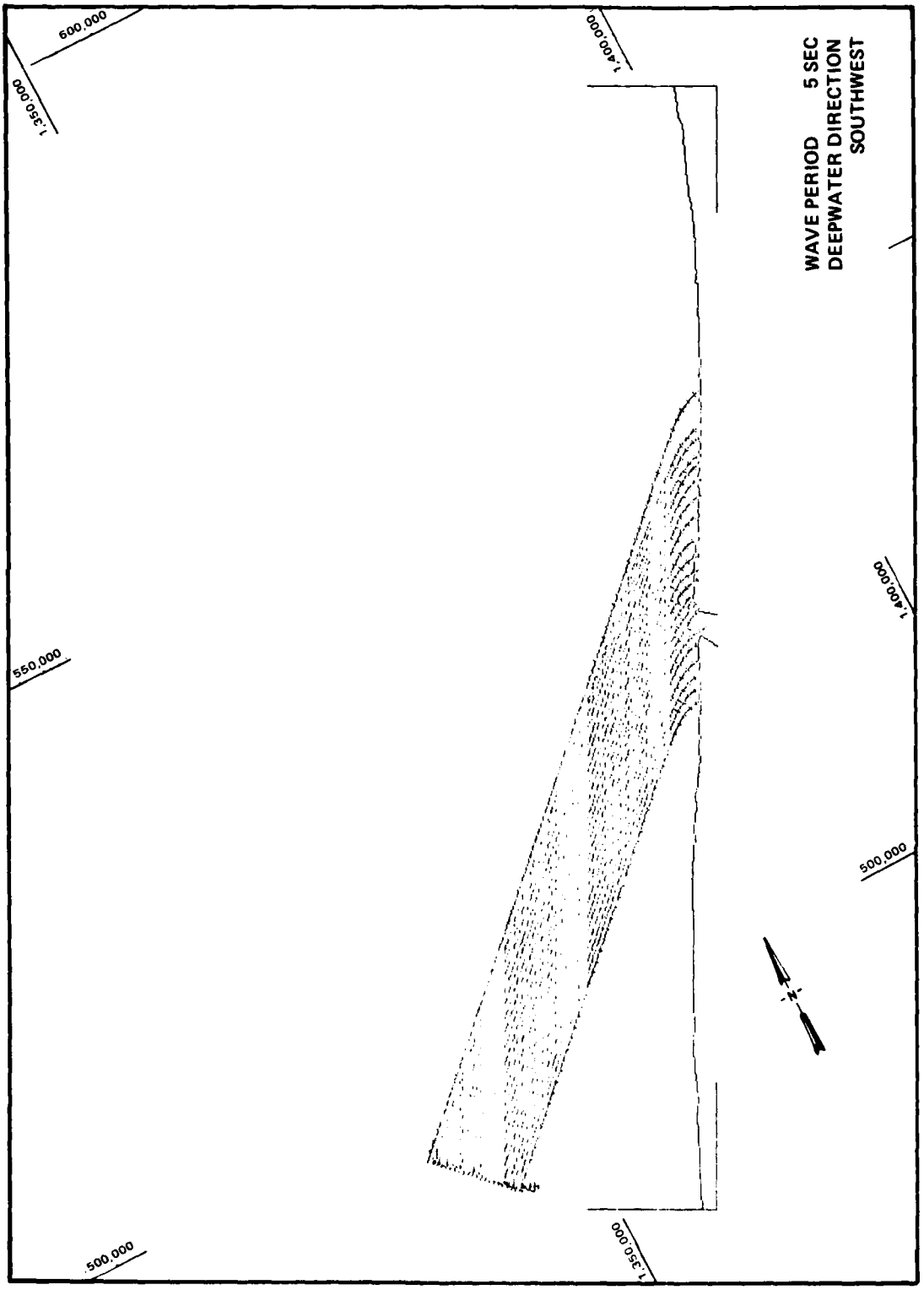
600,000
1,400,000
1,350,000
WAVE PERIOD 5 SEC
DEEPWATER DIRECTION
SOUTHWEST
1,400,000
550,000
500,000
500,000
1,350,000
N

PLATE A26

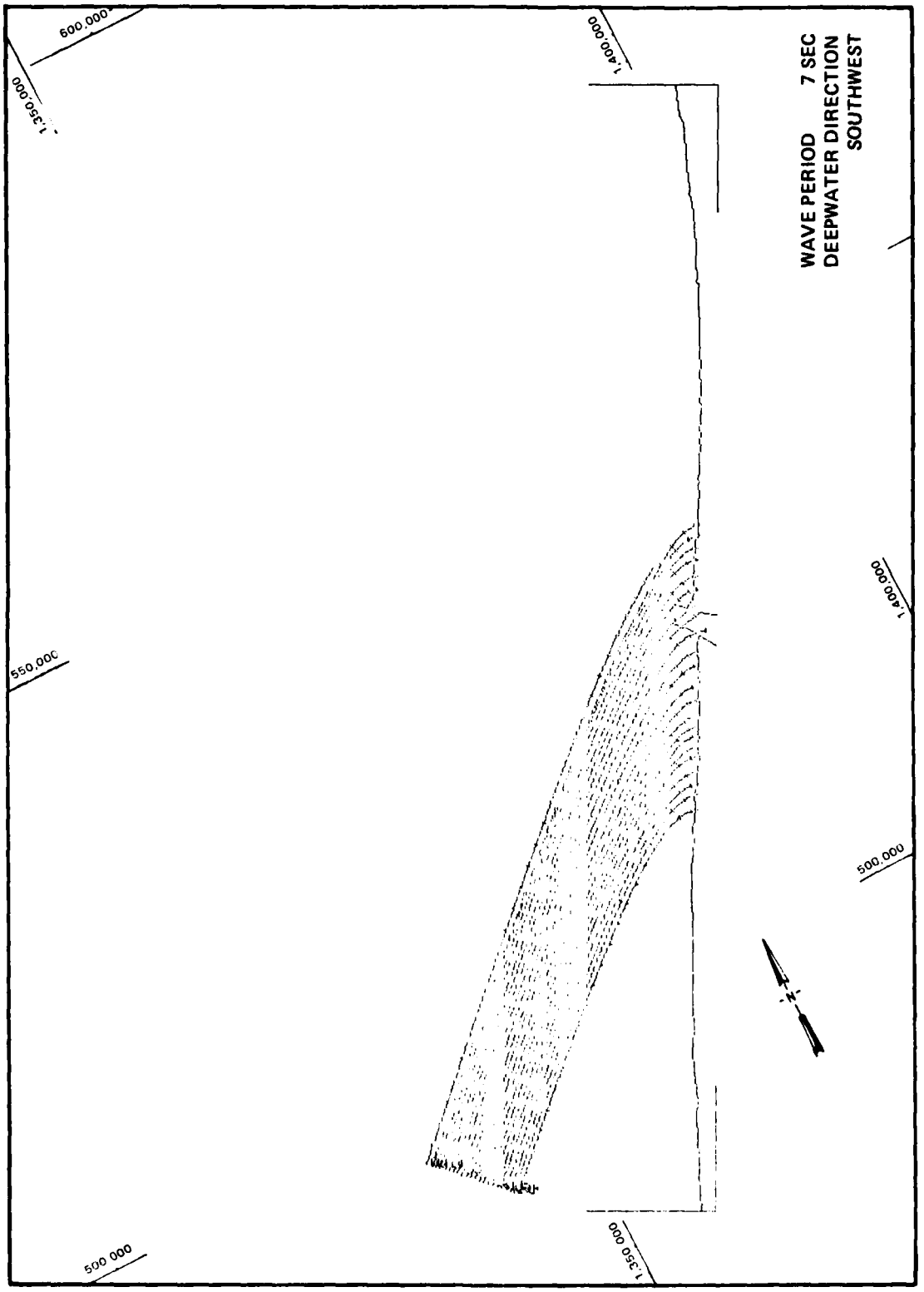
WAVE PERIOD 7 SEC
DEEPWATER DIRECTION SOUTHWEST
600,000
1,400,000
1,350,000
550,000
1,400,000
500,000
500,000
1,350,000
N

PLATE A27

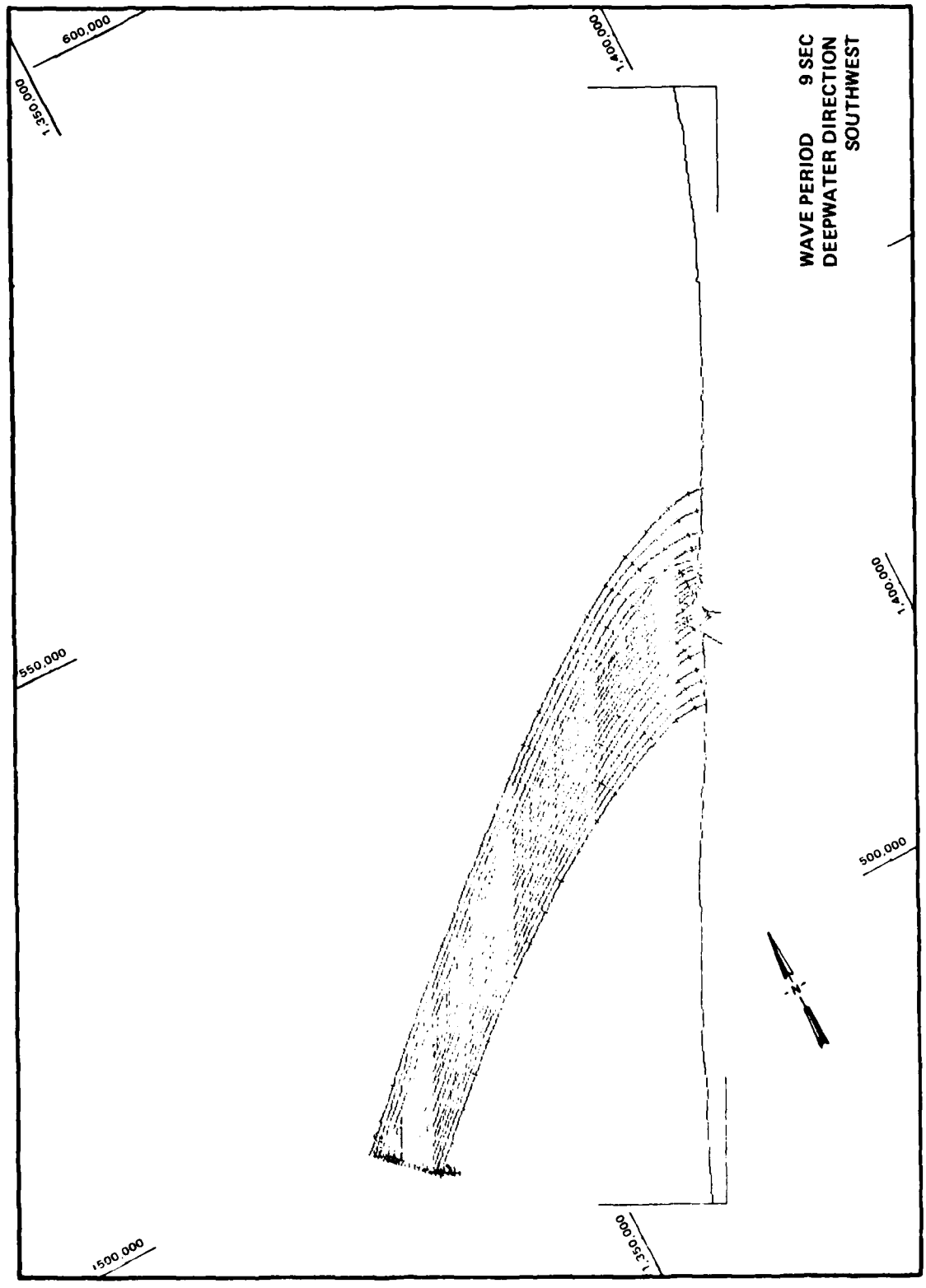
WAVE PERIOD 9 SEC
DEEPWATER DIRECTION SOUTHWEST
600,000
1,400,000
1,350,000
550,000
1,400,000
500,000
1,350,000
1500,000
N

PLATE A28

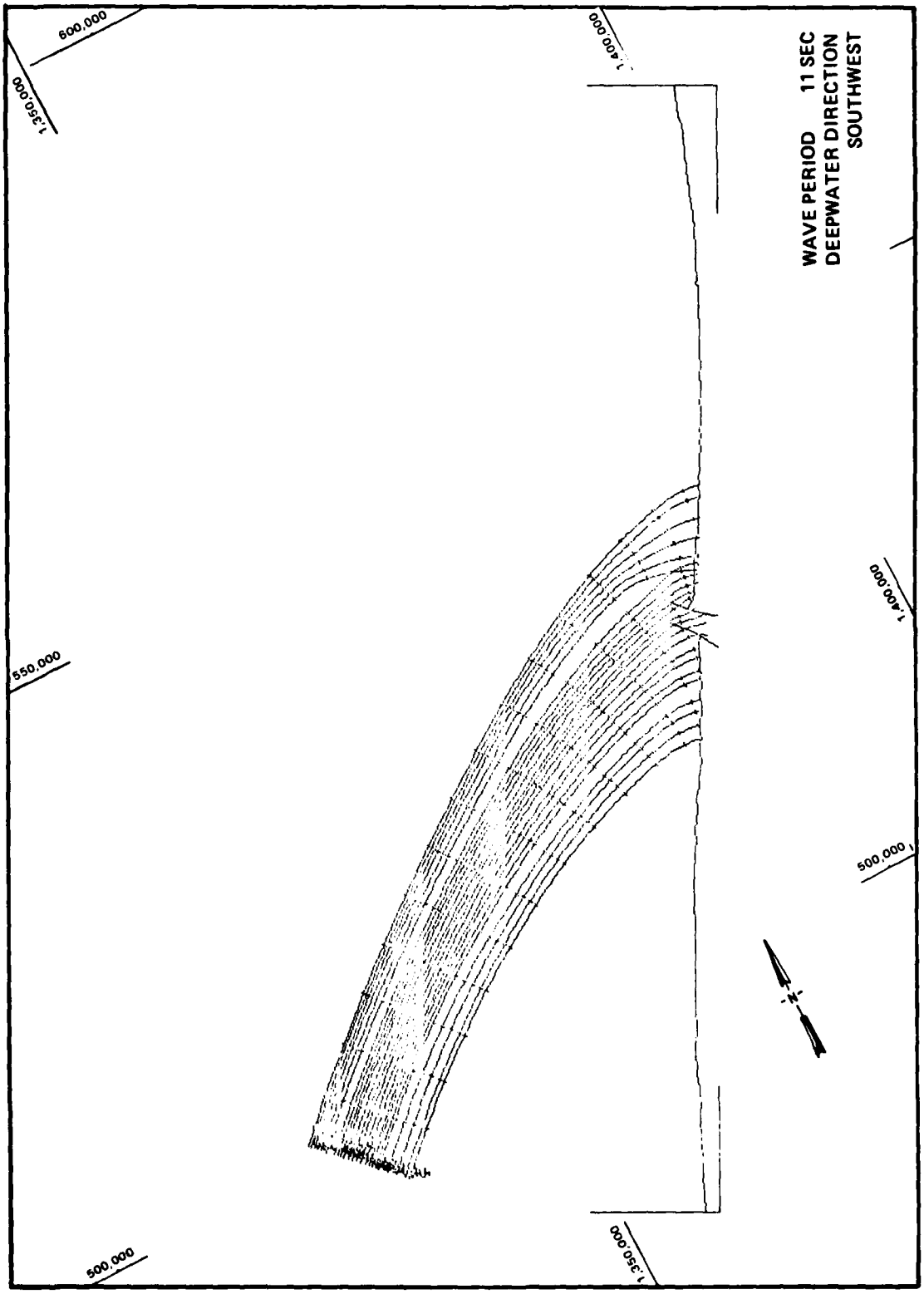
600,000
1,350,000
1,400,000
550,000
500,000
WAVE PERIOD 11 SEC
DEEPWATER DIRECTION
SOUTHWEST

PLATE A29

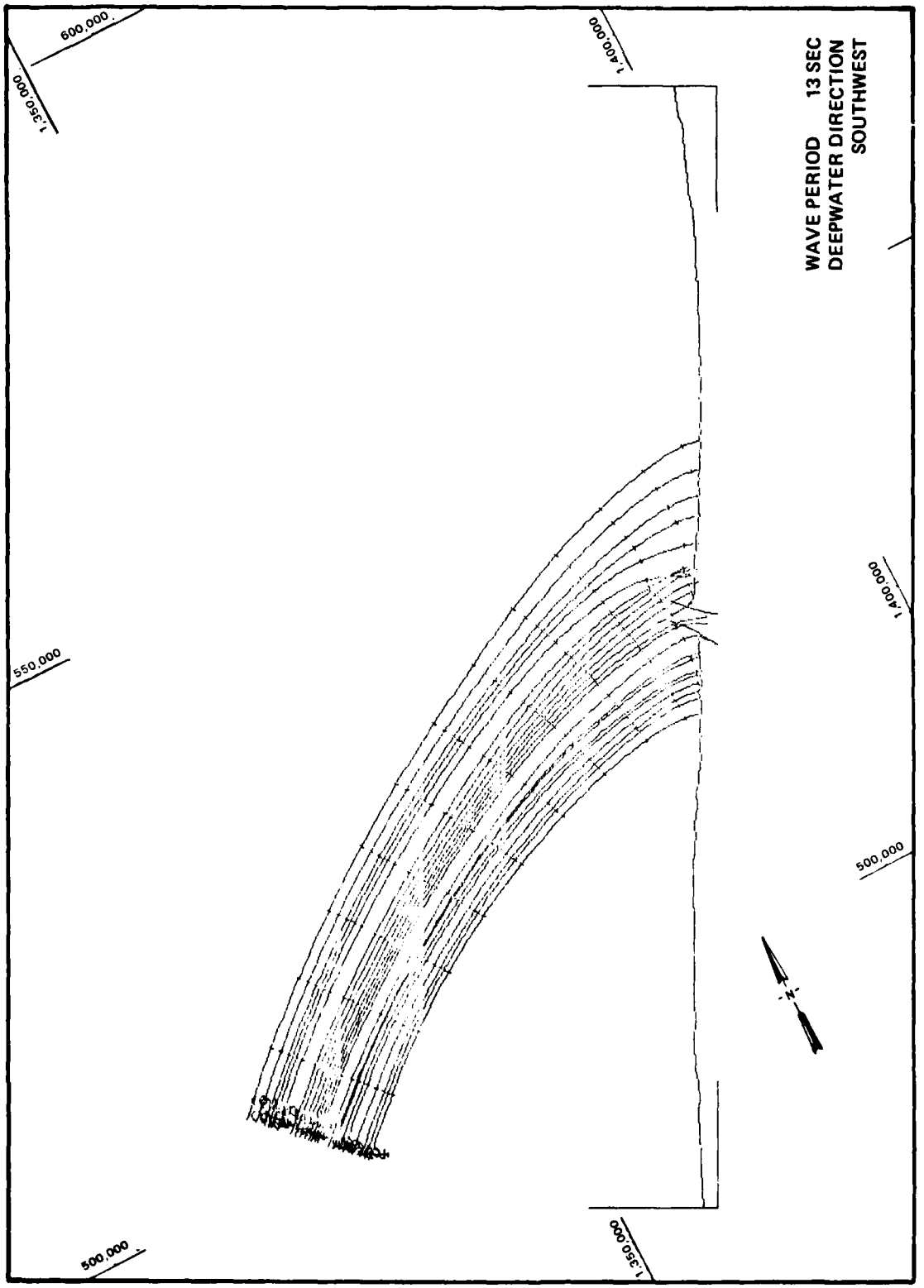
WAVE PERIOD 13 SEC
DEEPWATER DIRECTION
SOUTHWEST
600,000
1,350,000
1,400,000
550,000
500,000
N

PLATE A30

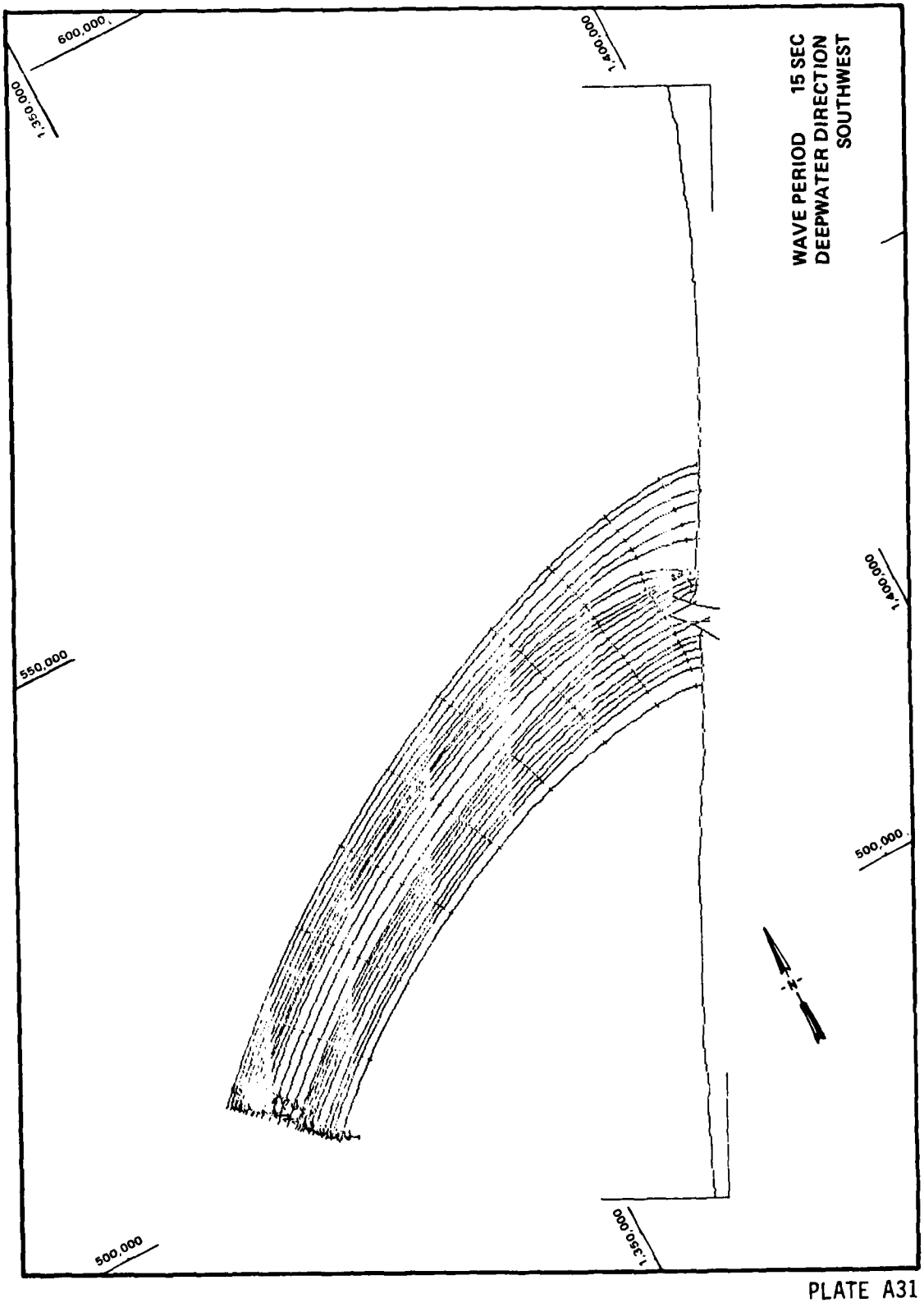
WAVE PERIOD 15 SEC
DEEPWATER DIRECTION
SOUTHWEST
600,000
1,400,000
1,350,000
550,000
500,000
N

PLATE A31

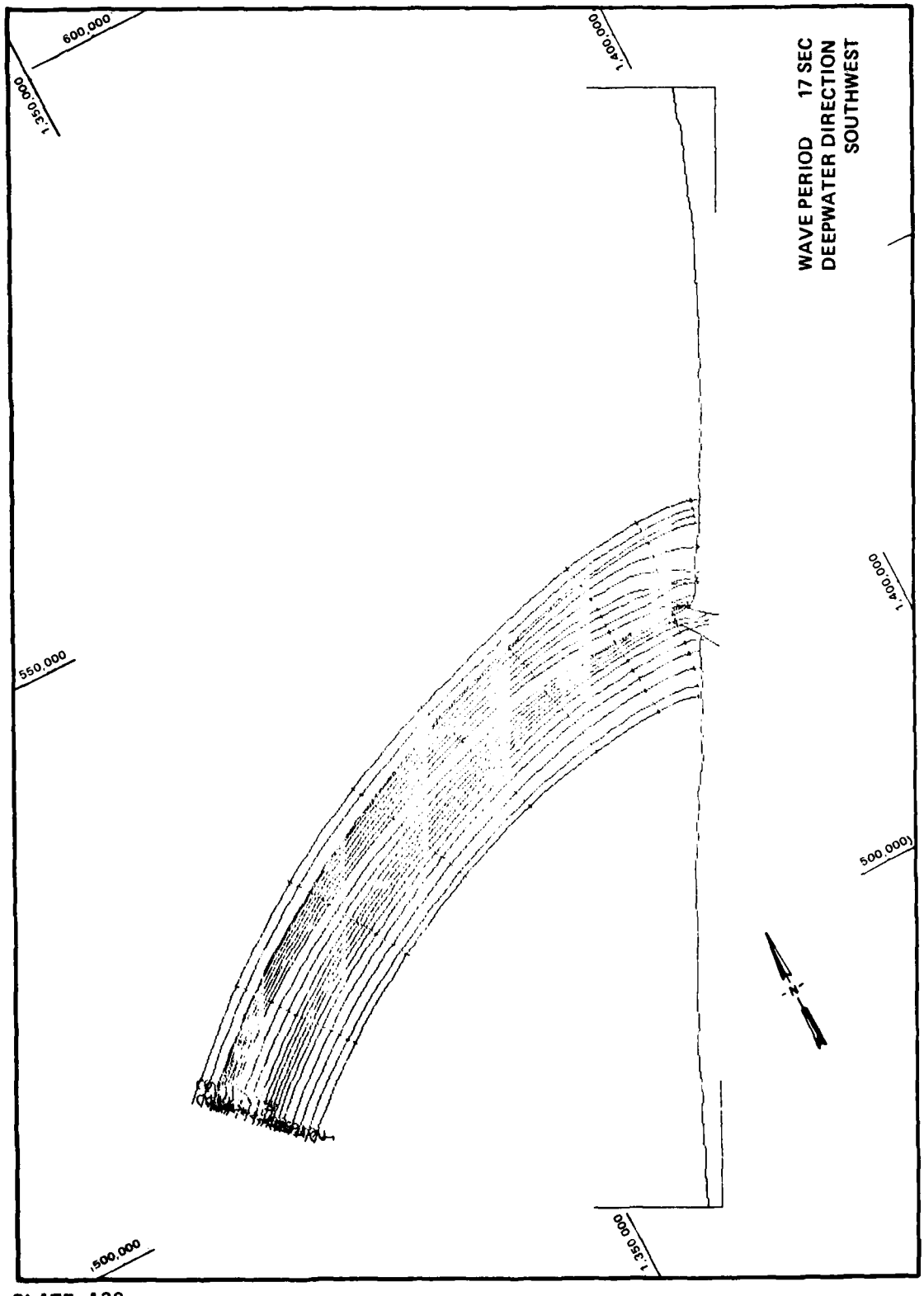
WAVE PERIOD 17 SEC
DEEPWATER DIRECTION
SOUTHWEST
600,000
1,400,000
1,350,000
550,000
1,400,000
500,000
1,350,000
,500,000

PLATE A32

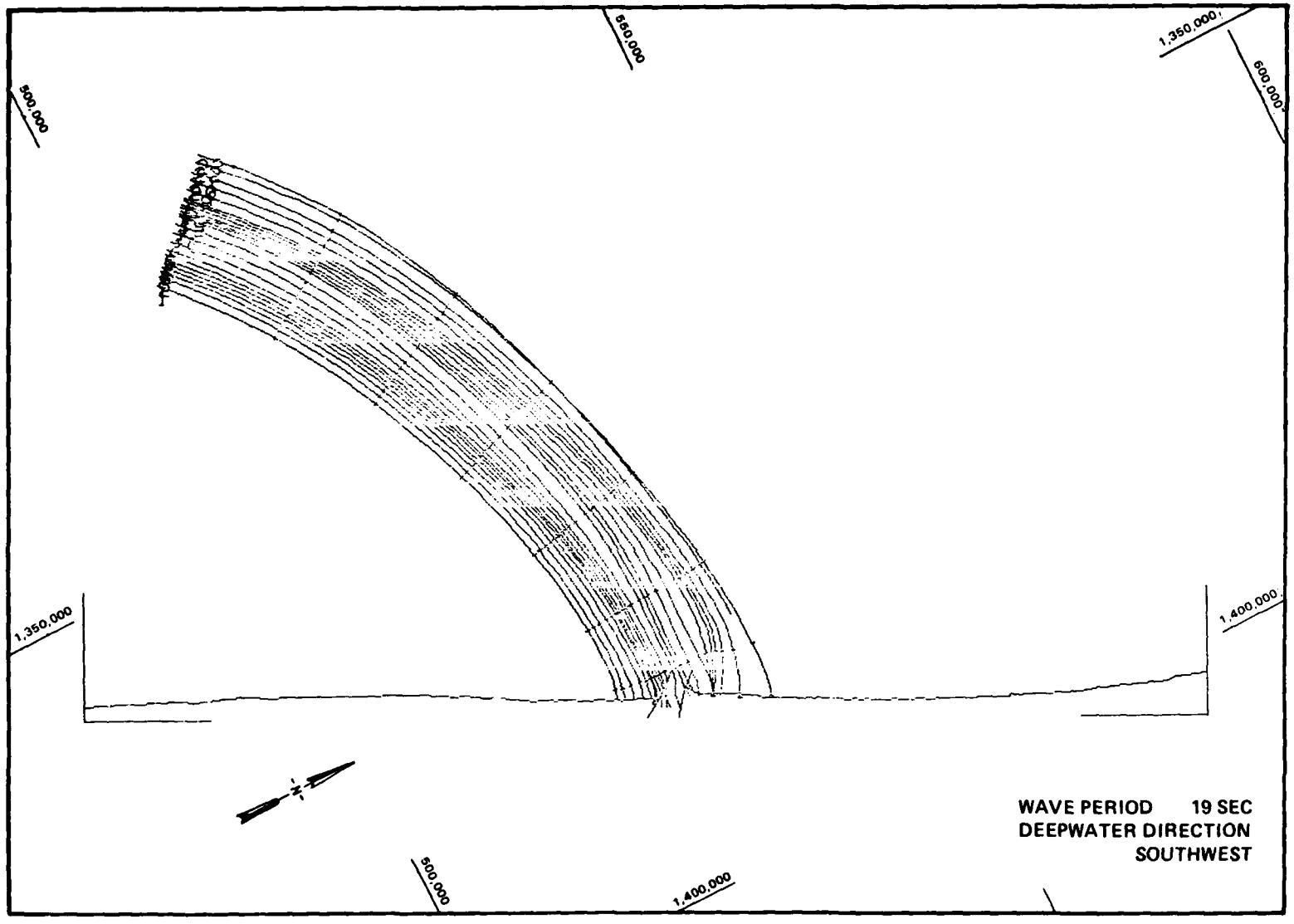
550,000
1,350,000
600,000
500,000
1,350,000
1,400,000
N
500,000
1,400,000
WAVE PERIOD 19 SEC
DEEPWATER DIRECTION
SOUTHWEST

PLATE A33

APPENDIX B: NOTATION

A	Area
b	Shallow-water orthogonal spacing
b_o	Deepwater orthogonal spacing
$(b_o/b)^{1/2}$	Refraction coefficient, K_r
D_{50}	Median particle diameter
H	Shallow-water wave height
H_o	Deepwater wave height
$H_{1/3}$	Significant wave height
K_r	Refraction coefficient
K_s	Shoaling coefficient
L	Length
Q	Discharge
T	Time
V	Velocity
$\forall$	Volume
γ	Specific weight
γ'	Apparent specific weight
η_D	Ratio of median particle diameter
η'_γ	Ratio of apparent specific weights
λ	Horizontal scale
μ	Vertical scale

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